FEB 25 1910


# JOURNAL OF ELECTRICITY

## POWER AND GAS

**Devoted to the Conversion, Transmission and Distribution of Energy**

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXIV NO. 8 | SAN FRANCISCO, FEBRUARY 19, 1910 | PER COPY, 10 CENTS



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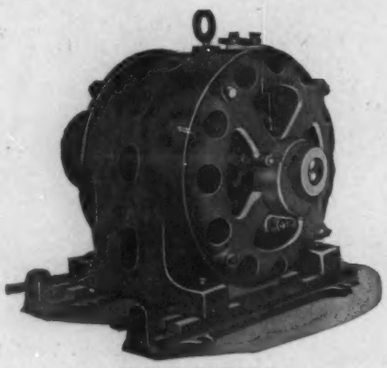

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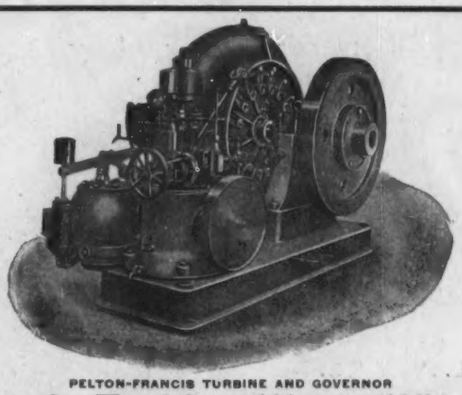

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIV SAN FRANCISCO, FEBRUARY 19, 1910. NUMBER 8

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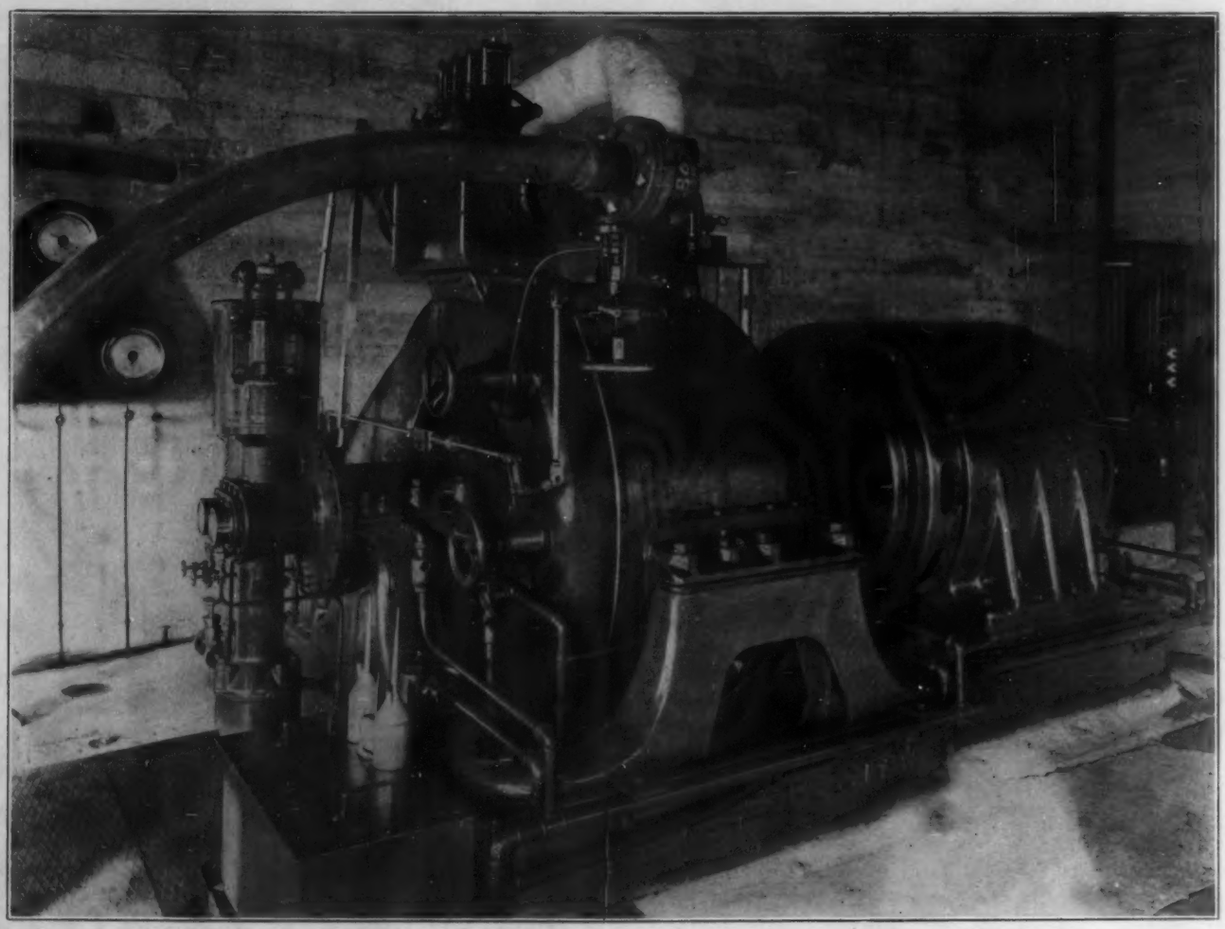
# LOW PRESSURE STEAM TURBINES.[1]

BY EARL O. SHREVE.

We are living in an exceedingly progressive age. We have seen the bipolar generator superseded by the efficient multipolar; belt drive changed to direct drive; the single truck street car give way to the modern car; the steam turbine replace engine generating sets, and many other important changes, but in no other case, I believe, have the possibilities been so great with so little first cost and without the necessity of discarding other apparatus as with the exhaust or low pressure turbine.



Mixed Pressure Turbine of E. K. Wood Lumber Co., Bellingham, Washington.

The high pressure steam turbine has revolutionized, in a very short time, the new steam electric generating plants, until today there are in operation, in the United States, steam turbines having an approximate

[1]Paper read before San Francisco Section, A. I. E. E., January 28, 1910.

aggregate capacity of 2,500,000 kw. The low pressure turbine offers economical possibilities for existing engine plants operating condensing or non-condensing which demand consideration, whether the engine is generating electricity, driving cotton mills, rolling mills, for hoisting plants, or for any use.

The steam engine is a very efficient piece of machinery when using steam from a high pressure and exhausting to atmosphere, but, from atmosphere down, it has inherent limitations which do not allow of the most efficient use of the steam. A good compound engine will not have space for expansion to more than fifteen times its original volume and a triple expansion more than thirty-five, whereas steam expanded adiabatically from 150 lb. to 28 in. vacuum increases in volume 96 times the original.

A steam engine, at best, can get only about 70 per cent of the energy from the steam. There are a great many engine plants operating non-condensing with steam consumption averaging 35 lb. per kw.-hour because, for the extra efficiency gained, the owners cannot afford to install condensing and auxiliary apparatus.

A very interesting paper on "Steam Engine Economy," read by Prof. J. E. Denton, in 1904, before the Mechanical Section of the International Congress of Arts and Sciences at St. Louis, gives the following: "The most economical piston engines, which, as we have seen, expand steam about thirty times, release their steam at the end of the stroke at 6 lb. absolute pressure; but they exhaust into a condenser which, with a vacuum of 28 in., contains a pressure of 1 lb. absolute per sq. in. If the expansion could continue until the pressure of 1 lb. was attained before exhaust occurred, considerable more work could be obtained from the steam. This, however, cannot be done in piston engines for two reasons; first, because the low cylinder would have to be about five times greater in volume, which is commercially impracticable, and second, because the velocity of exit through the largest exhaust ports possible is so great that the frictional resistance of the steam makes the back pressure from 1 to 3 lb. higher than the condenser pressure in the best engines of ordinary piston speed."

With a turbine, different conditions exist. It is the simplest form of turbine, having only the low pressure wheels, can be made amply large to take advantage of the best vacuum obtainable, has minimum radiation losses, and the lowest rotating loss that could exist because of working in a comparatively rare gas. Because of valve leakage, etc., in the engine, it is better practice to design the turbine to take steam at 1 lb. gauge pressure.

It is interesting to note that the amount of available energy in steam from 150 lb. to atmosphere and from atmosphere to 28½ in. vacuum is about the same, being 132,000 foot pounds per pound of steam in the former and about 130,000 foot pounds in the latter, allowing about 8 per cent for moisture.

There is just as much energy in steam expanded from 2 lb. to 1 lb. absolute as from 200 lb. to 100 lb. gauge. These results may be verified by a study of the adiabatic and isothermal expansion curves. From these facts, we readily see that almost unbelievable increases in efficiency may be obtained by combining the turbine with the engine.

To show the exact nature of what may be expected, I wish to introduce an interesting curve (Fig. 1) obtained from tests of a 22x44x42 Rice Sargent engine with d. c. 250 volt generator, and results obtainable from combining with a. c. low pressure turbine. At full load on the engine (1200 kw.) non-condensing, about 1000 kw. could be obtained from the exhaust steam by means of a low pressure turbine, which is a gain in capacity of 83 per cent.

At 2200 kw., or combined full load, the water rate is 16 lb. per kw.-hour and, as the engine running condensing uses 23 lb. and non-condensing 32 lb., we have an increase in efficiency of 30 and 50 per cent respectively with absolutely no increase in steam consumption over that of the engine when working condensing.

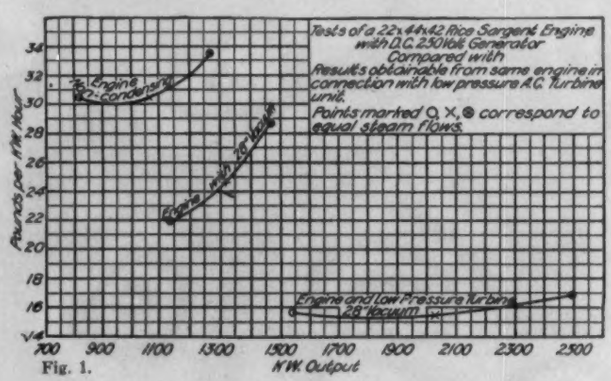


Fig. 1.

While, as stated before, many stations are operating non-condensing because it would not be advisable to install condensing apparatus to secure the small gain possible, it is evident that, with such a gain as obtainable in the above case, the extra expense would not only be feasible but almost demanded. An outline of the results that might be expected from a proposed installation of a mixed pressure turbine might be of interest here.

Engine capacity condensing 1200 h. p.; non-condensing without changing valves 880 h. p.; with steam consumption of about 22,000 lb. per hour. With these conditions, and exhausting the turbine to 28 in. vacuum, we obtain the following results:

| | | | |
|---|---|---|---|
| Engine h. p..... | 880 | Increased capacity ..... | 42.7 per cent. |
| Turbine h. p..... | 690 | Increased efficiency ..... | 30 per cent. |
| Total output .. | 1570 | same fuel. | |

Working under same conditions but with enough live steam to generate a total of 750 kw .with the turbine, we have these results:

| | | | |
|---|---|---|---|
| Engine h. p..... | 880 | Increased capacity ..... | 76.5 per cent. |
| Turbine h. p.... | 1060 | Increased efficiency ..... | 23 per cent. |
| Total capacity ... | 1940 | Increased steam consumed.. | 34 per cent. |

Working under the same conditions but resetting the valves so that full condensing capacity may be obtained from the engine operating non-condensing in connection with low pressure, we have:

| | | | |
|---|---|---|---|
| Engine h. p..... | 1100 | Increased capacity ..... | 74.5 per cent. |
| Turbine h. p..... | 820 | Increased efficiency ..... | 35.8 per cent. |
| Total capacity ... | 1920 | Increased steam consumpt'n.. | 20 per cent. |

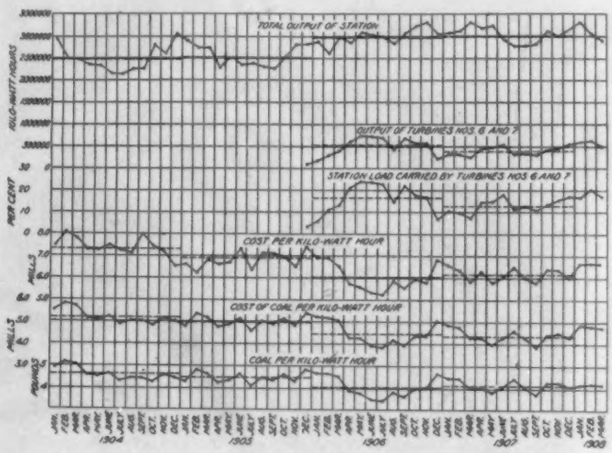
Additional live steam for 750 kw.:

| | | | |
|---|---|---|---|
| Engine h. p..... | 1100 | Increased capacity ..... | 96.4 per cent. |
| Turbine h. p..... | 1060 | Increased efficiency ..... | 27.9 per cent. |
| Total capacity ... | 2160 | Increased steam consumpt'n.. | 41.8 per cent. |

Of course, if this engine had been running non-condensing, the per cent increase in efficiency would have been nearly double.

It is an erroneous idea to assume that the engine with the poorer economy will give the most efficient combination result. The maximum economy depends just as much on the engine utilizing the steam to the very best advantage, obtaining the maximum amount of energy available, as upon the efficient operation of the turbine. The gain in capacity would be greater with inefficient engines and, as in some cases this end is desired, it may, sometimes, be of advantage to set the valves so as to pass a greater amount of steam than when set at the most economical point, but, where maximum efficiency is the object, the most efficient engines give the better results.

Each installation requires careful and independent




Power output and cost curves indicating increased capacity and economy secured by installing Curtis low pressure turbine sets. Philadelphia Rapid Transit Company, 13th and Mt. Vernon Streets Power Station.

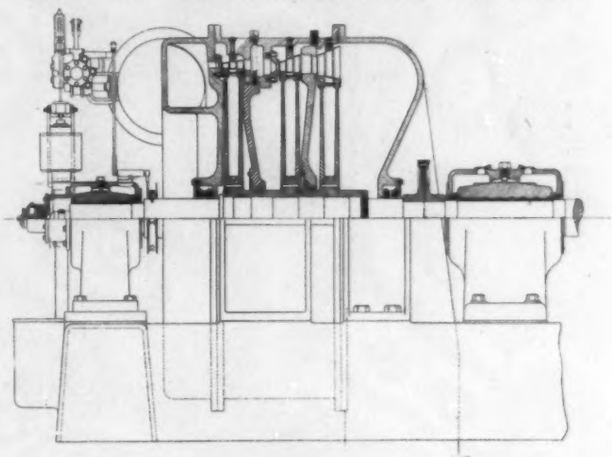
study as there are so many variable features which enter into an increase of this kind and the nature of the installation depends in every case upon the results desired, i. e., whether it is desired to increase the normal capacity, to increase the overload capacity, to obtain better economy without increase in load, or any combinations of the above.

In considering each case in a general way, as outlined, we will suppose in the first instance that one or more engines are already installed and that they all exhaust into a common header, if non-condensing, and into a condenser or condensers, if condensing. The size of the low pressure turbine will be determined by the amount of exhaust steam available and the amount of increased normal capacity desired. The turbine is connected to the common header in the first case and direct to the exhaust in the latter case. Of course, if there is more than one engine furnishing steam to a single turbine, they should be piped to a common header which, in turn, serves the turbine. In each case, a separator should be connected between the source and the turbine to extract the moistur of condensation.

In a case where the generator is to work in parallel with the machine driven by the engine (provided there is a single engine) there need be no governing mechanism. The leads from the low pressure machine may be connected permanently to the leads of the engine driven generator. This is the simplest form of installation and corresponds exactly to the addition of a low pressure cylinder to the engine. Should the load increase, the engine will pass more steam which will tend to speed up the turbine, thus automatically dividing the load. This, of course, is true only with a. c. machines.

This may be, and often is, a case where maximum station economy is a secondary consideration and it might be advisable to run as much steam through the engine as possible without causing excessive strains to the engine.

If peak capacity is desired, it becomes a question as to whether the conditions will require a straight low pressure unit or a mixed pressure which will be capable of operating on overloads on live steam. This, of course, depends upon the amount of exhaust steam available and the amount and duration of overload.



Assembly of 1000 k. w., 1500 r. p. m., low pressure horizontal Curtis steam turbine.

The next case of increasing efficiency without increase of load would mean the selection of a turbine which would give the most economical results at the same time operating the engine at its best economy.

In general, when considering plants such as rolling mills, hoists, etc., where the supply of exhaust steam is intermittent, it will be necessary or advisable to install regenerators into which the extra amount of steam will flow when there is an excess; then, when the amount is too small for the turbine, the regenerator will furnish the necessary amount. If such plants are shut down at times when it is necessary to run the turbine for longer periods than can be taken care of by regenerators, a mixed pressure turbine, or one arranged to use live steam, exhaust steam, or a combination of the two, should be installed.

An interesting installation of the mixed pressure type of turbine is in the Bellingham, Wash., plant of the E. K. Wood Lumber Co., as shown in the first page illustration. The turbine takes steam from a 750 h. p. Tatum & Bowen single cylinder, slide valve engine working non-condensing which has a approximate water rate of from 40 to 45 pounds per h. p. The load on the engine fluctuates from 300 to 900 h. p.

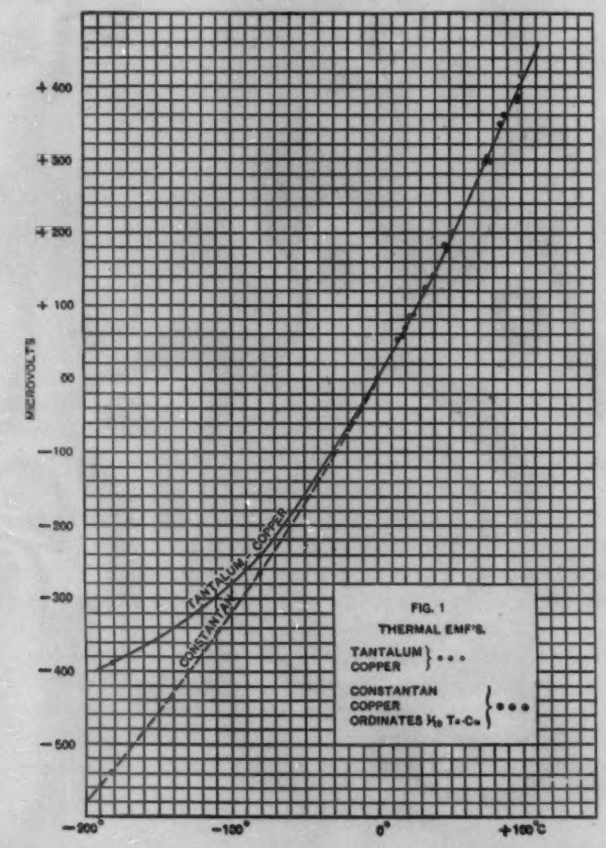
The exhaust turbine receives steam at varying pressures from 1 to 5 lb. gauge. This is possible with

a Curtis machine because the amount of steam admitted may be controlled by hand-valves with cut in or cut out nozzles to the first stage wheels. The customer estimates a saving in first cost due to this installation, over an additional engine unit, of approximately $10,000. The turbine generator is furnishing power to a railroad and carries a varying load of from 100 to 500 k. w.. These results were obtained with no addition to the boiler plant and represent an increase in efficiency of approximately 42 per cent and an increase in normal capacity of 70 per cent.

## THE THERMO-ELECTRIC BEHAVIOR OF TANTALUM AND TUNGSTEN.[1]

BY W. W. COBLENTZ.

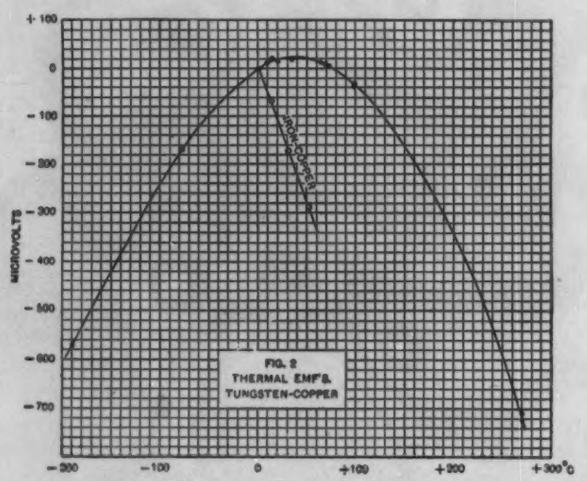
Tantalum is obtainable in fine wires; it is pliable and does not oxidize readily at ordinary temperatures, and hence suggests itself as a substitute for iron (steel) in connection with constantan wire in thermopiles. The following observations on the thermoelectric behavior of tungsten and tantalum may be of interest. The tantalum wire employed was 25 cm long and 0.048 mm in diameter. It was taken from an unused incandescent lamp. The resistance was 0.85 ohm per cm,




which was about 0.9 that of a sample of steel wire. The ends of the tantalum wire were wound tightly around copper wires, about 0.1 mm diameter, and then soldered. The copper wires were joined to a potentiometer, by means of a mercury reversing switch, and the comparisons made against a standard cell. Observations were also made on copper constantan and on iron constantan couples made of wires 0.0513 mm in diameter. The temperature was varied from 10 to 100 degrees, and an attempt was made to eliminate the lag of the mercury thermometer. Observations were also made at the temperature of liquid air and of solid carbon dioxide. The results are shown in Fig. 1, in which the black dots indicate the observations on the tantalum-copper couple drawn to scale. The observations at 10, 24, 32, and 47 degrees, respectively, belong to the first series. The observations at 17, 50 degrees, and higher temperatures were made on a new couple and show no marked variation from the preceding. The circles show the observations on the constantan-copper couple, the ordinates (microvolts) being drawn to one-tenth the scale of the tantalum couple.

The results show that throughout the range investigated the thermoelectric power of tantalum (against copper) is about 4.1 microvolts per degree, which is one-tenth that of the copper-constantan couple. The direction of the current is the same as in the copper-constantan couple.

The tungsten wire used in the present experiments was taken from a large "series" lamp. It was about 11 cm long and 0.26 mm diameter. To the ends were wound copper wires 0.1 mm diameter and covered with solder. Tungsten is very brittle, and the sample was




accidentally broken before the observations were completed, so that the observations at 231 and 269 degrees (the freezing points of tin and bismuth, respectively) were made with a length of wire less than 6 cm. long, the copper wires being fused to the tungsten. It was found that this did not affect the results.

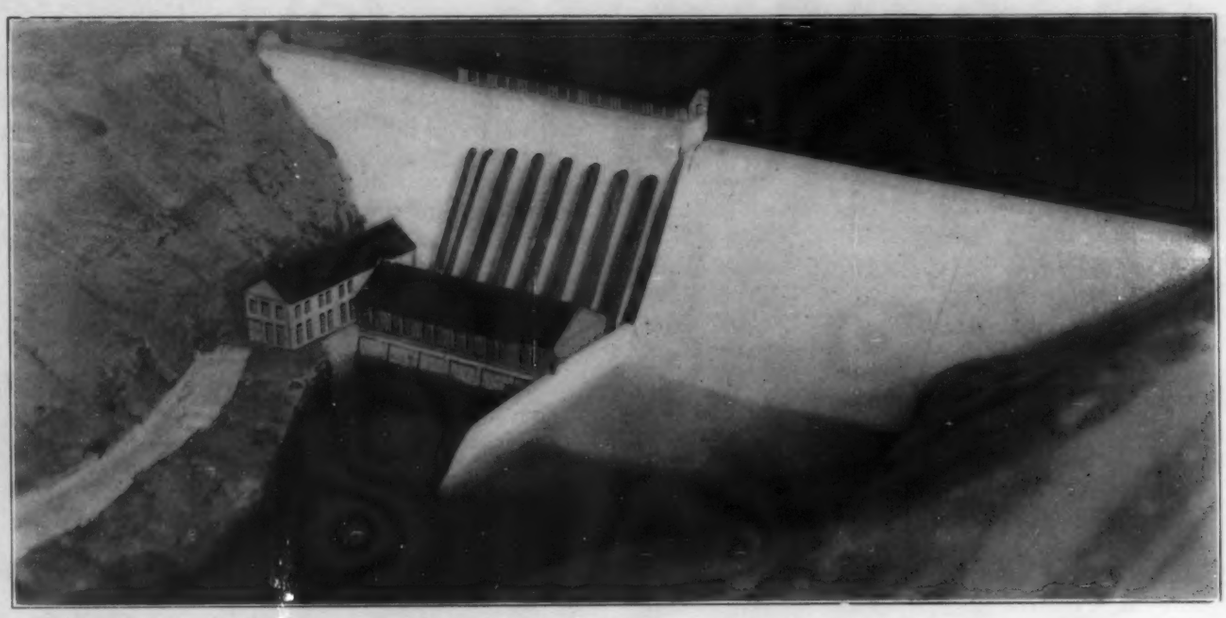
The thermal electromotive force curve of tungsten is given in Fig. 2, and is rather unusual in that its inversion temperature occurs at about 40 deg. c. Other combinations, which have an inversion temperature near 0 deg., are cadmium-iron at 170 deg. and copper-zinc at about 30 deg. c. From its appearance it is inferred that the thermoelectric curve is not a true parabola, as was also observed by Dewar and Fleming on numerous other metals. For temperatures below — 100 deg. c. the thermoelectric power (against copper) is about 3.5 to 4 microvolts per degree, while above + 200 deg. c. the thermoelectric power is about 4.5 microvolts per degree, so that tungsten, like tantalum, shows no apparent advantage in thermoelectric work.

[1]Bulletin of the Bureau of Standards.

## THE UPPER CLACKAMAS DAM.

As supplementary to the various articles that have appeared in these columns regarding the system of the Portland Railway, Light & Power Company's system in the vicinity of Portland, Oregon, the accompanying picture of a model of the proposed upper Clackamas development is interesting.

This model was constructed by Sellers & Rippy of Philadelphia, Pa., who are the consulting engineers for the company on this property. The model measures about three feet square and is true to contours and scale and represents very closely the finished appearance of the plant. The development proposed shown by this photograph consists of six 9000 h. p. turbines direct connected to six 5000 kw. generators operating under a normal head of 130 ft. The head available is



Model of Upper Clackamas Dam.

created by the construction of the dam with the maximum height of 180 ft. The spillway section is 133 ft. high from crest to bucket and when completed we believe it will be the highest spillway dam in the world. During times of maximum flood a depth of 12 ft. of water will be discharged over the crest of the dam.

Preliminary field work has been on the way on this development since 1907, and since June 1, 1908, resident engineers representing the consulting engineers have been located on the property.

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**Telephonic delivery of letters** has been adopted by the London postoffice to care for those messages mailed too late for delivery on Saturday, and consequently held till Monday. When it is desired to have the contents of the letter telephoned on Sunday it must be inclosed in an envelope addressed to the Central Telegraph Office in London, and a broad line must be marked across the envelope from top to bottom. Postage stamps to the value of three pence (6 cents) for every thirty words must be forwarded.

## GOVERNMENT POLICY TOWARD WATER POWER DEVELOPMENT.

Included in the extensive discussion of Henry L. Doherty's paper "Comments on the Development and Operation of Hydroelectric Plants," contributed at the New York meeting of the A. I. E. E. on December 16, 1909, and abstracted in these columns on December 18, 1909, was considerable comment on the attitude of the Federal Government relative to the development of water power. These remarks are here summarized as an expression of engineering opinion on this important question.

H. W. Buck stated that there has been a great deal of literature circulated during the past year which has given false impressions about the fabulous value of water powers as they exist in nature. As a matter of fact, a mountain stream in the wilderness has practically no value whatever in itself. It is only when it is combined with a very large expenditure of money, ranging perhaps from $100 to $200 per horsepower, together with the expenditure of a great deal of brain power in management, financing, and engineering, that this natural geographical situation, called a water power, derives a value. This value is contributed to only in a small degree by the water in its natural state. In this respect the people have a false idea about the value of those properties which the government has lately refused to give over to private enterprise for development.

Furthermore, when a waterpower is developed and is successful, it is profitable only in a reasonable degree. At the present time active competition exists between waterpower and power from various forms of heat engine, and this condition is likely to continue for many years. Even good water powers cannot compete with power generated from steam at low load-factor in parts of the country where coal costs less than, say, $2.00 per ton. People have been led to believe that a water power is an absolute power monop-

oly, but such we all know is far from the fact. The government also apparently assumes that water powers, will, for all time, continue to be the only source of power. This hardly seems to be justified. The most efficient heat engine today has perhaps a commercial efficiency of 20 per cent, and there is therefore a large margin for possible improvement and economy in this form of engine. A slight improvement would still further increase competition with water power. Furthermore, the energy of waterpower is merely converted energy of the sun. It is quite possible that other means for the utilization of the sun's energy may develop in future generations. The attention of the government is directed toward the preservation of water powers for the sake of posterity. It may be that when posterity arrives the energy of water powers will not be required at all, other sources of energy having superseded its use; and in the meantime the prevention of waterpower development represents a sacrifice for present generations and the loss of a great industrial opportunity.

The government also seems to have adopted a discriminating attitude against water powers as distinguished from other natural resources. Economically there is no difference between a waterpower and any other form of natural resource. It is a situation in nature which can be developed for reasonable profit. So can timber lands, mines, farm lands, and all other property be developed and their potential value liberated for the benefit of mankind; but the agitation against the private development of waterpower as the one natural and injurious monopoly, without reference to all other forms of natural resources seems to be a very one-sided form of socialism and an unjust discrimination against those who are interested in the development of waterpower.

H. A. Storrs wrote that Mr. Doherty's comments must appeal to all engineers in the West, who are in a position to know the effect of the present conservation movement on hydroelectric enterprises. His remarks are specially opportune just now, when the government, through its officials, is calling for legislation and shaping policies looking to better control of our natural resources. It is true that in the past the government's efforts to exercise control over waterpower developments have been "largely misdirected or very generally misunderstood." Especially does this seem to be the case from the point of view of those who have found the former untrammelled conditions conducive to large gains on small speculative investments. It is not so much a matter of inducing public officials to take the "proper attitude" toward the development of our water powers, as of bringing about proper legislation to enable public officials to have some definite basis of authority on which to act. Our government officers, if given definite, comprehensive laws under which to work, and sufficient funds to enable them to perform the required work, can furnish a basis for future development of the waterpower possibilities of the country that will give a stability to hydroelectric enterprises not possible under the present chaotic conditions.

Referring to Mr. Doherty's statement to the effect that the efforts of the government to exercise some control over waterpower developments seem to be obstructing rather than encouraging such enterprises, the particular case presented below will serve to show what results may be expected if the present government policy is enforced. The National government cannot, however, under the present laws, exercise general control over the waters of non-navigable streams, since this authority is vested in the separate States. But, under the Act of June 4, 1897, the Secretary of Agriculture has full power to regulate the occupancy and use of the natural forests. Through the Forestry Service, therefore, the government deals with prospective power plants, storage reservoirs, conduits and transmission lines, so far as they may be located within the limits of the forest reserves. The essential features of the government's policy as stated recently by the chief forester in a letter published in The Outlook, December 4, 1909, are: first, that the right to develop waterpower on the forest reserves shall be granted for a limited term of years and not for all time; secondly, that a reasonable charge shall be made for the privilege granted. The application of these principles is illustrated by the following case.

Under date of November 24, 1909, permission was granted by the Forestry Service, covering the occupancy and use of certain lands in one of the national forests in Colorado, for the storage reservoir of a power generating plant. The principal features of the terms under which the permit was granted are as follows:

1. Payment to the United States, annually in advance from September 1, 1909, until the beginning of use of the waters for which permit is granted, at the approximate rate of one dollar per acre of reservoir area and five dollars per mile of conduit for the land occupied by such works.

2. Payment to the United States of a gross operating charge, based on the total electrical output of the plant per year, at the following rates per 1000 kilowatt-hours:

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|---|---|---|---|---|---|---|---|---|---|
| For the | 1st | year | | | | | | 2 | cents |
| " " | 2d | " | | | | | | 4 | " |
| " " | 3d | " | | | | | | 6 | " |
| " " | 4th | " | | | | | | 8 | " |
| " " | 5th | " | | | | | | 10 | " |
| " " | 6th | to | 10th | years | inclusive | | | 12½ | " |
| " " | 11th | " | 15th | " | " | | | 15 | " |
| " " | 16th | " | 20th | " | " | | | 17½ | " |
| " " | 21st | " | 25th | " | " | | | 20 | " |
| " " | 26th | " | 30th | " | " | | | 22½ | " |
| " " | 31st | " | 35th | " | " | | | 25 | " |
| " " | 36th | " | 40th | " | " | | | 27½ | " |
| " " | 41st | " | 45th | " | " | | | 30 | " |
| " " | 46th | " | 50th | " | " | | | 32½ | " |

Certain deductions are allowed from the "gross" charge in case: (a), the title to part of the watershed has passed out of the United States; (b), the conduit is not wholly on government lands; (c), the power is derived in part from water stored in a reservoir constructed or owned by the permittee.

The following table shows the gross charges as determined for the project under consideration:

TABLE I.

| Year | Output: Average kilowatt per day | Output: Average kilowatt hours per day | Output: 1,000 kilowatt hours per year | Rate per 1,000 kilowatt hours | Annual charge |
|---|---|---|---|---|---|
| 1912 | 3,000 | 72,000 | 26,000 | 2 cts. | $525.60 |
| 1913 | 5,000 | 120,000 | 43,800 | 4 cts. | 1,752.00 |
| 1914 | 7,000 | 168,000 | 61,320 | 6 cts. | 3,679.20 |
| 1915 | 10,000 | 240,000 | 87,600 | 8 cts. | 7,008.00 |
| 1916 | 12,000 | 288,000 | 105,120 | 10 cts. | 10,512.00 |
| 1917 to 1921 | 12,000 | 288,000 | 105,120 | 12.5 cts. | 13,140.00 |
| 1922 to 1926 | 12,000 | 288,000 | 105,120 | 15 cts. | 15,768.00 |
| 1927 to 1931 | 12,000 | 288,000 | 105,120 | 17.5 cts. | 18,396.00 |
| 1932 to 1936 | 12,000 | 288,000 | 105,120 | 20 cts. | 21,024.00 |
| 1937 to 1941 | 12,000 | 288,000 | 105,120 | 22.5 cts. | 23,652.00 |
| 1942 to 1946 | 12,000 | 288,000 | 105,120 | 25 cts. | 26,280.00 |
| 1947 to 1951 | 12,000 | 288,000 | 105,120 | 27.5 cts. | 28,908.00 |
| 1952 to 1956 | 12,000 | 288,000 | 105,120 | 30 cts. | 31,536.00 |
| 1957 to 1961 | 12,000 | 288,000 | 105,120 | 32.5 cts. | 34,164.00 |

3. Payment for all timber destroyed in the forest reserve.

4. Construction of the works to begin within 18 months from date of approval of the permit; construction to be completed and operation of the works for the purpose intended to begin within 3 years from date of approval of permit.

5. The United States reserves, conditionally, the right to purchase power at as low a price as that allowed to any other purchaser.

6. The permit is not transferrable.

7. The permit shall be forfeited to the United States, if the works be controlled by an unlawful trust, or if they be used in restraint of trade in the sale of electric energy.

8. The permit shall cease and be void at the end of 50 years but is renewable upon conditions not yet fixed.

For the purpose of comparing the government charge to be paid for the waterpower privilege with the annual income of the plant, the following table has been prepared showing what per cent of total gross receipts must be paid to the government:

TABLE II.

RATIO (IN PER CENT) OF GROSS ANNUAL CHARGE TO GROSS ANNUAL INCOME.

| | Sale price of delivered power per kilowatt-hour. 1c. | 2c. | 3c. | 4c. | 5c. |
|---|---|---|---|---|---|
| 1912 | 0.2 | 0.1 | 0.07 | 0.05 | 0.04 |
| 1913 | 0.4 | 0.2 | 0.13 | 0.10 | 0.08 |
| 1914 | 0.6 | 0.3 | 0.2 | 0.15 | 0.12 |
| 1915 | 0.8 | 0.4 | 0.27 | 0.20 | 0.15 |
| 1916 | 1.0 | 0.5 | 0.33 | 0.25 | 0.20 |
| 1917 to 1921 | 1.25 | 0.625 | 0.42 | 0.31 | 0.25 |
| 1922 to 1926 | 1.5 | 0.75 | 0.5 | 0.38 | 0.30 |
| 1927 to 1931 | 1.75 | 0.875 | 0.58 | 0.44 | 0.35 |
| 1932 to 1936 | 2.0 | 1.0 | 0.67 | 0.50 | 0.40 |
| 1937 to 1941 | 2.25 | 1.125 | 0.75 | 0.56 | 0.45 |
| 1942 to 1946 | 2.5 | 1.25 | 0.83 | 0.63 | 0.50 |
| 1947 to 1951 | 2.75 | 1.375 | 0.92 | 0.69 | 0.55 |
| 1952 to 1956 | 3.0 | 1.5 | 1.0 | 0.75 | 0.60 |
| 1957 to 1961 | 3.25 | 1.625 | 1.08 | 0.81 | 0.65 |
| Average..... | 2.085 | 1.0425 | 0.695 | 0.52 | 0.417 |

The table shows that for the 50-year period the average payment to the government is about 2 per cent of the gross receipts, at a sale price or valuation of 1 cent for each kilowatt-hour, delivered by the plant, and about 1 per cent at a valuation of 2 cents per kilowatt-hour.

Applying these figures to the case in hand, assuming the average value of the electric power during the 50-year period to be 1 cent per kilowatt-hour, the gross annual receipts would be about $1,000,000 and the average annual payment to the United States would be $20,000.

In response to inquiry, asking what privileges and benefits were secured by paying to the United States the above "conservation" charge, the Forest Service replied as follows:

"The conservation charge is based on the value of the land occupied for the particular use to which the land is to be put, and on the special benefits the permittee received by reason of the care and administration of the natural forest including the protection of the watershed from fire and destructive cutting which materially affect the water sources."

The permit in hand was secured for the benefit of a project comprising a storage reservoir of 10,000 acres superficial area, of which 260 acres only were within the boundaries of a forest reserve. It follows that the annual payment of $1.00 per acre for the three years allowed for construction amounts, in this case, to only $260; whereas, if the entire reservoir had been in the reserve, a payment of $10,000 per year would have been required. It is presumed that the object of this heavy initial tax on the enterprise is to compel immediate construction of the works, thus preventing the power possibility from being held, undeveloped, for speculative purposes. Speculation in undeveloped water powers on forest reserves is still further guarded against by making the permits non-transferrable.

The recommendations of the Secretary of the Interior, in his recent annual report, are generally in line with the present practice of the Forest Service, except that he would limit the life of the permit, or "easement," to 30 years, allow four years for accomplishing the first quarter of the proposed development, and require that transfer be made to the United States of the water rights necessary to provide for the estimated power development.

In view of the probability that, during the next decade electrical power will be applied extensively to the operation of railroads in the West, the policy and methods of the government in exercising control over water powers located on government lands are subjects of great practical moment to the country at large. They deserve the careful consideration of engineers who are in a position to influence the trend of legistion and of public opinion.

O. S. Lyford, Jr., speaking of a similar permit, stated that the tax, if the drainage area and hydraulic conduit were entirely on forest reserve, and if the entire estimated power were marketed, would amount to about $350 for the first year and $5600 for the 50th year. The estimated annual operating cost of the total output of the plant including fixed charges is $180,000. Therefore, in such a case an hydroelectric development entirely on forest reserve would, under these terms, be subjected to a tax of from 0.2 per cent to 3.1 per cent of the total annual operating cost. The charge during the first year is not considerable. Whether the charge for the later years will prove reasonable will depend on the taxes and other burdens which may be imposed on the power company by the State.

The principal burden placed upon the power company under this permit is the 50-year limitation, with no definite assurance that the improvements made by the company will not in effect be confiscated at the end of the period by refusal to renew.

## GOVERNMENT SPECIFICATIONS FOR ELECTRICAL APPARATUS.[1]

BY CHAS. F. SCOTT.

The story of the Atbara Bridge, which an American firm proposed to erect and actually did erect in less time than foreign manufacturers required for the completion of their drawings, is an international example of the American use of standards. The specifications called for the erection of a bridge of definite capacity, without including detail particulars. Had they not been broad enough to admit the American standards, the American bidders would have been excluded, or rather new designs, special materials and long delay would have been involved. We all know that American manufacturing has won its success because things are made in large quantities in standard sizes. It is reasonable, therefore, to expect that the policy of the American government would be to follow the American method, by putting a premium upon standards and standard specifications. The government, as a large purchaser, should be the last to create a demoralizing interference in industrial methods by calling for things which are not standard, but involve special requirements and distinctions, often of little or no vital consequence. And yet cases may be cited in which the course pursued by the government has fostered specialization and irregularity, often involving complication and higher prices with no compensating advantages.

As an instance of an extreme condition, and the way in which it was remedied, I cite the following statement which has been given me regarding incandescent lamps.

When the question of purchasing incandescent lamps in large quantities for the several departments of the government was taken up and investigated about five years ago, it was found that the Treasury Department had one specification; the Bureau of Yards and Docks of the Navy another; the Bureau of Equipment of the Navy a third; the Quartermaster's Department a fourth; the Library of Congress a fifth; the government printing office a sixth; the Post Office Department a seventh, and the Bureau of Engraving and Printing an eighth. While nearly all of the lamps were substantially the same and there were but few unusual requirements, yet no two of these specifications agreed and great difficulty was experienced by the manufacturers in understanding just what type of lamps should be furnished under any one of them. To eliminate this difficulty the Bureau of Standards and the government engineers of the several departments held a meeting in Washington to discuss the subject of standardization of specifications and appointed a committee which met with a similar committee appointed by the incandescent lamp manufacturers. This joint committee drafted what is known as the government standard specification and today when one department of the government requests proposals on standard specifications, they are the same as the specifications of any other department, excepting in isolated cases, for example, the Navy Department which requires some special lamps. The standard specifications have eliminated a great deal of difficulty on the part of the lamp manufacturers and the government engineers as well.

A further illustration of the same kind is afforded by rubber insulated wire. In this case, however, I am informed that the work has not yet been carried to completion. On the investigation of the specification for standard rubber covered wire, it was found that the Navy Department's Bureau of Equipmem had one specification, the Navy Department's Bureau of Yards and Docks another, the Library of Congress another, the Treasury Department another, the Quartermaster's Department another, and there were perhaps one or two other peculiar specifications. On looking over these specifications, they ran a complete line from the poorest competition wire which would comply with the National Board of Fire Underwriters' manufacturing specifications, to the most elaborate specifications for 36 per cent Para rubber insulation; notwithstanding the fact that the wire was to be used under virtually identical conditions. In investigating this matter the question of wire for ship-board purposes was taken into consideration and it was found that with few exceptions, all specifications for wire could be embodied under a few general heads.

A further instance which has been cited in the same connection is with regard to motors. When the question of specifications for motors was looked into, it was found that the same variance takes place in the specifications: For example, the temperature requirements of a motor covered the entire line from operation at full-load for an hour with a rise of 75 degrees F., to operation continuously for 24 hours at 25 per cent overload with a considerably less rise of only 63 degrees F. Such variance in the requirements for motors would apparently cause the manufacturer to make up special apparatus to comply with each specification.

As an example of the non-conformity of specifications and lack of co-operation, it may be cited that in one instance three bureaus were represented in the specifications for apparatus which was to be operated in conjunction, and in which controlling panels for various motors were to be installed in a single room or compartment. One of the bureaus specified a water-tight control panel; another, a switchboard enclosed in a non-water-tight sheet iron case, and the third entirely open panels. Three types of control apparatus were, therefore, to be installed in conjunction, in the same compartment.

It is easy to criticise and to show the absurdities in such divergence in specifications as are afforded by the foregoing instances. They certainly are not the result of any established policy; but are examples of certain practices which have grown up under past conditions. In discussing the subject, there are several features which should be considered:

1—The government as a purchaser has, in many cases, prepared its specifications before suitable commercial standards were established and recognized. This was undoubtedly the case as regards lamps and

[1] A paper delivered at the U. S. Engineer School, Washington Barracks, Washington, D. C., December 15, 1909, and printed in the Electric Journal.

wire. In the matter of rubber covered wire, for example, one of the largest electrical manufacturing companies, which is an extensive user of such wire, found a few years ago such chaos in wire specifications and such divergence among the regular products of different wire manufacturers, that it was compelled to make its own purchasing department specifications for rubber covered wire. This was not done in an arbitrary way, but by considering carefully the various standard makes and after consultation with the various manufacturers, a standard list was prepared which would meet the requirements and would impose a minimum inconvenience upon those who furnished the wire. Obviously, it is impossible for the government to use standard specifications if there are no standards.

2—Another reason why government specifications are apt to appear arbitrary and call for special apparatus is due to the tendency to enter into particulars and to do designing. It is hard for the engineer, government or other, to restrict himself to general requirements and not yield to the temptation to enter into details which should concern only the designer of the apparatus. Ordinarily, the purchaser should not be the designer; or if he is, he must take the consequences in restricting competition, in uncertain deliveries, in the extra cost which such products usually involve and he should properly share the responsibility for what he designs.

3—Apparatus may be specified to meet exactly certain definite requirements, although it may be entirely feasible to adapt or modify the conditions so that standard commercial apparatus may be used. For example, in designing a mechanical structure, it may be calculated that an I-beam of certain dimensions will exactly meet the requirements. If these are different from those of standard sizes, its manufacture would involve delay, inconvenience and extra cost. On the other hand, the use of a standard I-beam would probably require only slight modifications in the conditions, or in the arrangement of other parts. Likewise, in arranging machines to be operated by a motor, it may be found that some odd horsepower at some unusual speed, or certain special forms or dimensions of bed plate or bearings happen to meet the exact requirements, whereas, some slight modification in the arrangement might enable a standard motor to be employed. In some instances this cannot be done, as new requirements justify special construction, but such cases are the exception. A demand for something special, when that which is standard might be used, shows inferior rather than high engineering ability. The best engineer seeks to adapt his conditions so that he may utilize the things at hand, the standard products which are upon the market.

4—Some of the men who are called upon to prepare specifications have been trained in government schools, and in government service, and have never had experience in manufacturing or commercial work, and hence they often do not have a first-hand technical and practical knowledge of the matters involved. Men who have not had a commercial training may not have developed the instincts of economy of the ordinary commercial engineer, and are more apt to yield to the temptation to specify what they want, regardless of what is available and regardless of cost.

5—Another alleged reason why government specifications have not conformed to ordinary practice is that the government officials are in a position of authority and are sometimes arbitrary, unyielding and apt to be controlled by technicalities. It is quite likely, on the other hand, that government officials have regarded the manufacturers as inordinately commercial, putting their individual interests far above engineering excellence or government efficiency. But whatever weight such consideration may have, it does not fall within the range of the present discussion to enter into personal criticism.

Some of the results of arbitrary action, however, both in the issuing of specifications and in the acceptance tests of apparatus, react upon the government and place it at a commercial disadvantage. Apparatus will cost more if, when inspected and tested, it is liable to be rejected on technicalities, for the manufacturer must charge extra to cover this liability, and in the long run manufacturers may decline to bid, thereby reducing competition. Much depends upon the spirit in which the specifications are interpreted. An ordinary business man, particularly when he asks for something in which the conditions are new, is satisfied if the specifications are approximated within a certain reasonable range, particularly if the essential and useful elements are satisfactory, and the apparatus accomplishes its purpose. But the government inspector has the reputation of demanding his "pound of flesh." As an example, a machine adapted for both alternating and direct current was sold to the government. It was intended to state in the specification that the alternating current voltage should be "approximately 70 per cent" of the direct current voltage, but a typographical error made the figure 73 per cent. The machine was not acceptable because the actual ratio was about 70 per cent. It was a matter impracticable to change on account of certain inherent elements depending on the arrangement of the windings and the width of the field poles, which proportions were selected in order to secure the best commutation and the best general performance of the machine. In this case, a general approximate descriptive statement (which was a typographical error) was interpreted as a rigid guarantee, and a variation from it was treated as if it were as serious as a failure of several per cent in efficiency. The operating excellence and adequacy of the machines were not questioned, but the miserable little matter of ratio caused long drawn-out annoyance, friction and delayed payments.

In another case, certain small generators were supplied for shipboard operation, which on test were found to have a temperature rise which exceeded the specified limit by a few degrees. The apparatus, if rejected, would be of little or no value to the builder, as it was special. The outfits were eminently satisfactory, except in the trifling excess temperature. The inspector who made the test reported that they were the best machines he had ever seen, and were satisfactory, except in the one point of temperature. The actual temperature rise was a trifle more than the government specification, but was less than ordinary

commercial standard practice. The "pound of flesh" was exacted in the form of a penalty equal to nearly one-half the value of the generators, which turned a manufacturer's small profit into a large loss. The result was that the manufacturing firm which had thus been penalized has declined to make further bids when importuned to do so by this Bureau.

In a certain specification for a machine for a special service, the specification contained a clause the meaning of which was not clear. Literally, it either meant nothing or specified a physical impossibility. A more liberal interpretation indicated a desirable and proper characteristic. The designer took the commonsense interpretation and did what was practical and useful. The machine met its acceptance test satisfactorily, except that it did not literally comply with the impossible requirements. The inspector declined to accept the machine. The matter was investigated. It was found that the original writer of the specification did not know what the particular paragraph meant, but he had seen an attractive phrase somewhere and had incorporated it. The machine was finally accepted, but the conference between the inspector and his superiors had caused a delay in shipment and for this a penalty was incurred, which the manufacturing company had to pay.

It is easy to criticise specifications and tests and to cite past specific experiences as horrible examples of how things should not be done. It is also easy to demonstrate the value of standard specifications. It is quite another matter to prepare ideal specifications. This is especially true of electrical apparatus where there must be constant evolution and development to keep up with increasing requirements and improvements in design. Commercial specification should form a definite basis for present work, but they should not restrict progress.

The whole matter of specifications for the purchase of material and apparatus is a complicated one. There are two sides to it, one concerning the user, the other concerning the manufacturer; first, what is necessary to perform the required service, and, second, what is commercially or practically available. The company with which I am connected is a large purchaser of materials. Many of these are ordinary commercial products; others involve special requirements on account of the uses to which they are put. We do not arbitrarily specify what we would like to have, but we consult freely with the manufacturers to determine how our needs can be best met by what they are in position to furnish. We recognize that we are not experts in their products and we enter into conference with them, and in many cases results have been secured through conference and co-operation which could not otherwise have been attained. In a few cases, we have been accused of having scientific experts, who do not know the practical uses and essential qualities of the material, write up the specifications, using various scientific terms and proposing theoretical and scientific tests. Such a specification is usually modified by conference. Our real aim, however, is to write specifications which will provide a reasonable, practical measure of the ability of the material to meet the requirements for which it is to be used.

A number of years ago, the American Institute of Electrical Engineers recognized a confusion among manufacturers, consulting engineers and users, which arose from imperfect standards. There was a topical discussion on the standardizing of generators and transformers at a meeting in January, 1898.

It was pointed out that while it would probably be impracticable to establish definite sizes or lines of apparatus that would be satisfactory to all concerned and it should not be the object of the Institute to introduce standards which the evolution of business would soon render useless, yet there were certain features which could properly be taken up by the Institute, notably the definitions of terms used in specifications, uniform methods of rating apparatus, methods of conducting tests, etc. A committee was appointed and its report was issued in June, 1898. This report has been revised twice and was issued in its present form in June, 1907, as the "Standardization Rules of the American Institute of Electrical Engineers." Various matters relating to definitions of terms, performance specifications and tests, which may be adopted in general practice for making definite and uniform the specifications between manufacturers and purchasers, are presented in a simple, practical way. No attempt is made to dictate sizes, speeds, dimensions, and the like. The aim is to define what a specified load really means and how it should be measured; what elements are involved in efficiency and how they should be measured; what constitutes a reasonable rise in temperature and how temperature should be measured. These standardization rules have been proposed and revised by a large representative committee, including experts connected with government bureaus, engineers from manufacturing companies, consulting and operating engineers and scientific experts. The rules have been submitted in preliminary form to expert engineers for criticism and suggestion. They, therefore, represent the best practice. The rules do not purport to be scientifically abstruse, nor to cover all cases; for example, in connection with definitions, this note is given: "The following definitions and classifications are intended to be practically descriptive and not scientifically rigid"; and in connection with insulation tests: "The voltage and other conditions of test which are recommended, have been determined as reasonable and proper for the great majority of cases, and are proposed for general adaptation, except where specific reasons make a modification desirable." It is common practice in commercial specifications and tests to follow methods laid down in these standardization rules. Incidentally, they are quite comprehensive in their scope and bring together in concise form a very large amount of engineering data and information. One man who read through the rules carefully remarked that he felt that he had reviewed his whole college course.

**Electric Motor Specifications.**

An admirable presentation of the elements which should enter into a commercial specification is contained in a paper presented to the American Association of Electric Motor Manufacturers by Mr. R. S. Feicht, chairman of its committee on government specifications, in May, 1909. The subject is so well discussed that I shall quote at length from the paper.

The purpose of motor specifications for large consumers is:

1—To insure a uniform grade of apparatus of a satisfactory quality and performance.

2—To enable the purchasing department to place orders for motors without the necessity of securing special engineering advice and with the assurance that the proper motors will be obtained for the particular applications involved.

With these points in mind, let us see whether we can establish some of the important characteristics of an ideal set of motor specifications.

1—They should be written in a clear concise manner so that there can be but one interpretation for each statement and no two parts should be in any way contradictory. These are particularly vital points as the specifications are made up for the use of the motor manufacturer and the representative of the customer, who are usually not consulted in writing the specifications, and, therefore, are not familiar with the intent of the specifications unless the wording of them is unmistakable.

The use of such phases as "perfect mechanical balance," "without sparking," and "satisfactory operation" should be carefully avoided as a literal interpretation of them may cause the rejection of any machine however well designated and constructed. Perfect mechanical balance is attained by accident only. Absolutely sparkless commutation is practically impossible. Satisfactory operation depends entirely upon how easily the witness may be satisfied. It is not right that a manufacturer should be put to the expense of building a motor, the acceptance of which is entirely dependent upon the personal equation of a witness. The wording of the specifications should be such that the manufacturer will be in a position to know positively before the witness test is made that the motor will or will not meet the specifications in every particular.

2—Ideal specifications should contain a general description which will permit the use of any well recognized standard apparatus for the purpose, thereby insuring competition in bids. They should be broad and liberal so as to permit the usual variations in design. It should be recognized by the writer of the specifications that the future development of the motor depends upon variations in the present designs and, therefore, unnecessary restrictions, which serve no good purpose but simply throttle development, should be avoided.

3—Ideal specifications should either omit performance guarantees altogether and leave them to the bidder to supply, or should give them slightly lower than the average, preference being given in the awarding of the contract to motors with the highest performances, other things being equal.

4—Ideal specifications should cover the tests which are to be made to determine whether the motor meets guarantees and, recognizing the unavoidable variations in workmanship and materials and with what degree of accuracy the tests can be made in a commercial testing room, they should specify within what limits the results of tests are to be considered as meeting guarantees.

We often find in specifications for motors that certain points are covered which should obviously be omitted. In the following a few of these points are noted:

Certain characteristics of a motor are at times specified which in themselves are of no particular moment, but which affect other characteristics covered by the guarantees. In other words, the end is specified in the guarantees and in addition the means of attaining the end are covered by general requirements. As an example of this feature, we often find in specifications that temperature guarantees are specified for full-load and over-load and in addition the question of ventilation is covered. Now, if the temperature guarantees are met, the question of inherent ventilating characteristics is of no importance whatever to the customer. Again some specifications cover efficiency guarantees very minutely and in addition specify that the losses in the motor shall be a minimum or that the best grade of iron shall be used to minimize the losses, etc. Here, also, if the efficiency guarantees are met, the question of losses and quality of material used are irrelevant and serve only to handicap the designer.

Some specifications, though apparently written on a liberal and unprejudiced basis, distinctly discriminate against certain designs of apparatus or against apparatus manufactured by certain companies. This practice, of course, should not be countenanced unless the particular design discriminated against is one which is not considered a recognized standard.

Some specifications cover methods of testing which are not considered accepted standards and which, therefore, involve the manufacturer in unnecessary expense in preparing for witness tests.

The principal defect of the present government specifications is that they do not, in the majority of cases, permit the use of standard apparatus which has proven satisfactory to the general trade. It is inconceivable that the requirements of the government should be such that it is necessary for manufacturers to build a special line of motors for its use. We do not believe that any such necessity really exists, excepting for apparatus to be used in the equipment of war vessels. In this paper, we are not referring to this class of apparatus, but simply to that which is used by the government for land service in applications similar in all respects to that of ordinary users.

The types, classifications, and nomenclature of the present specifications differ from those of the A. I. E. E. and A. A. E. M. M. which we now consider recognized standards.

The most elaborate witness tests are specified to be made at the expense of the manufacturer. We see no reasonable excuse for the government requiring more elaborate tests than are required by other users, nor can we see any necessity for witness tests being specified for all motors.

We see no reason for the government specifications not being of such a character that they may be used by the small consumer and public in general, as guides in the purchase of motors without the fear that unnecessary special features will be involved, which will interfere with prompt deliveries and increase the cost over that of standard apparatus.

The frequency with which government specifications are issued is one of the greatest objections to them. The present specifications have been in force less than a year when completely new ones are proposed. Since January, 1902, four sets of specifications have appeared, making an average of one in about every twenty-two months. If these specifications are made up properly, they should hold for a much longer period unchanged, and, with slight changes and additions to keep pace with the development of the apparatus covered by them, they should remain in force indefinitely. It is practically impossible for a motor manufacturer to change designs of motors as rapidly as the government specifications have been changed without serious losses from apparatus rendered obsolete, and it is, therefore, very desirable that the new specifications be made to agree with the most modern practice and that changes in them thereafter excepting for good cause be discouraged.

As indicated, the paper from which the foregoing extracts are taken was presented before the American Association of Electric Motor Manufacturers, an association which is accomplishing some highly satisfactory results. Its methods may be taken as a good example of the right way to do things. The manufacturers have gotten together with a view of standardizing their products. By invitation of the Bureau of Construction and Repair of the Navy Department a con-

ference was held in Washington on May 28 and 29, 1909, at which were represented six bureaus and nine motor manufacturers, a total of twenty-eight men. Preliminary specifications had been issued by the government engineers; these were freely discussed, paragraph by paragraph. A final specification has since been issued substantially agreed upon and practically conforming to the rules and recommendations of the A. A. E. M. M. These specifications apply to all departments of the Navy Yards and Stations and are suitable either for the government or the public. They were issued after Mr. Feicht presented his paper; hence his criticisms were directed at the earlier specifications and not those now in force.

After the conference Electrical Expert Aide, M. W. Buchanan of the Bureau of Construction and Repair of the Navy, made the following statement with regard to the way in which the work had been done:

"The valuable discussions on points where opinions diverged and the interest maintained throughout a rather long and tiresome conference, also the cheerful spirit which obtained under trying conditions, were all the subject of very favorable comment by the officers of the Bureau."

Obviously, it should be unnecessary for each of half a dozen or more bureaus and departments to prepare its own specifications for the same thing. There should either be a conference between departments, or some one department should prepare the specifications. While this could not be carried beyond certain limits, there is a very large list of ordinary standard productions, the specifications for which could be satisfactorily prepared in this way. This method has been carried out by the Bureau of Standards with respect to incandescent lamp specifications and electrical measuring instruments, and specifications are now being prepared for transformers after consultation with representatives of the governmental departments and several manufacturers. This is certainly a logical and sensible method and is capable of great benefits to the government.

Standard government specifications, prepared in conference with the manufacturers, including tests which will determine the practical utility of the apparatus, and acceptable both to the government and to the manufacturers, will not only benefit both parties, but will be accepted by the public. Therefore, the government, instead of being a disturbing element in industrial manufacture, may become a useful instrument in establishing standard commercial specifications which will be a great aid in standardizing American products. Both the general public and the manufacturers would welcome such specifications, assigning to them the weight which should properly be attached to engineering work of the government.

There has been very substantial progress away from the conditions which are exemplified in some of the instances of unsatisfactory specifications and tests which have been cited. There is a change from the old-time attitude, in which the government in an ill-advised or arbitrary way, gave little consideration to commercial standards and methods, and, on the other hand, in which commercial interests looked upon the government as a legitimate field for the sale of poor apparatus at high prices. There is a growing disposition within the government bureaus to work together in engineering matters along the lines which modern business development has shown to be the most efficient. There is every reason why harmony and co-operation between departments and between the government and commercial interests should lead to mutual advantage. The government should foster the best industrial methods and practices. The engineering and commercial interests of the country should take a pride in government work—the government is theirs and they should, with a broad patriotic spirit, take pride in the excellence and economy with which its engineering functions are performed.

## REPORT OF WISCONSIN COMMITTEE ON WATER POWER.

The report of two members of the special legislative committee on water powers, forestry and drainage, Senators Paul Husting and Henry Krumrey, just made, shows that the amount of horespower available on the twelve principal streams of the State of Wisconsin, namely, the Wisconsin, Fox, Wolf, Chippewa, Black, Menomonie, Peshtigo, Oconto, St. Croix, Rock, Flambeau and Milwaukee rivers is 827,900 horsepower, and of this amount 183,105 horsepower has been developed.

The committee recommends the levying of ten per cent on the annual franchise value per horsepower. By annual franchise value is meant the difference in cost between the production of power by waterpower and the production of power by coal at the same place in like quantities and under like circumstances. It was also recommended that the State should fix the location, height, and general construction of the dam in order that the power may be developed to the highest potential efficiency, and that provisions should be made to prevent monopolization of power.

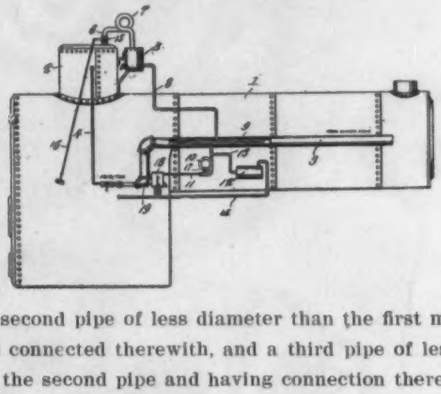
## UNDERGROUND ELECTRIC RAILWAY YARD.

Blasted out of solid rock, two miles underground, in the heart of a mountain near Mullan, Idaho, is a fully equipped railroad yard with electrically propelled cars handling the rich lead-silver ore produced by the Morning mine, owned by the Federal Mining and Smelting Company. The work, which has just been completed under the direction of Charles K. Cartwright, required more than a year and and involved the expenditure of several hundred thousand dollars and the labor of many men.

The yard, which is the only one of its kind in the Northwest, and is believed to be the largest underground mine yard in America, is 200 feet in length and 36 feet in width, the height ranging from 20 to 100 feet. The electrical apparatus and hoisting machinery are in a chamber, 50 by 78 feet and 20 feet high, while in the rear of the four-compartment shaft, now under construction, is an ore bin, 20 by 26 feet and 50 feet high, with a capacity of 1,500 tons. The shaft will be sunk to reach a depth of 2,600 feet.

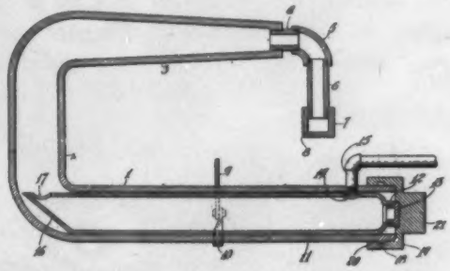
# PATENTS

**948,881. Means for Preventing Boiler Explosions.** Julius V. Hoffmann, Jasper, Ind. In means for preventing explosion of steam boilers, a pipe having connection with the highest point of the steam boiler so as to carry off the dry steam or



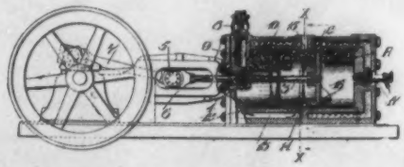
gases, a second pipe of less diameter than the first mentioned pipe and connected therewith, and a third pipe of less diameter than the second pipe and having connection therewith and with the water supply pipe.

**948,921. Oil Burner.** William H. Creswell, Los Angeles, Cal. An oil burner comprising a U-shaped body portion having a lower horizontal arm, an upper horizontal arm, and a vertical arm connecting the lower and upper arms, said arms



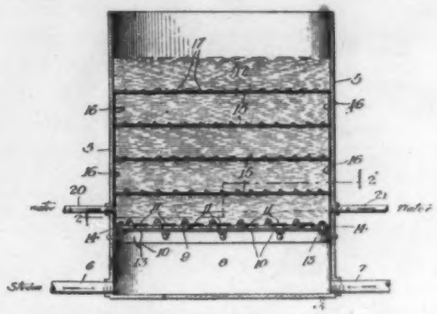
being formed of a single casting, a short pipe depending from the upper arm and provided with a nozzle to project the flame toward the lower arm of the body portion, and means for admitting oil to the lower arm of the body portion.

**948,860. Two Cycle Gas Engine.** John M. Johnson, Alfred C. Johnson and August Johnson, Sunnyvale, Cal. In an engine of the character described, the combination of a cylinder closed at both ends, a piston adapted to reciprocate in said cylinder, a piston rod extending through the outer ends of the cylinder, a crank shaft to which the outer end of said rod is



connected, an inlet valve at one end of the cylinder, said cylinder having a passage at one end connecting with said valve and adapted to admit an explosive mixture to the outer portion of the cylinder, a pipe extending substantially parallel with the axis of the cylinder having one end connecting with said inlet passage and the other end leading toward the piston, said cylinder having its compression chamber formed between the piston and the end of the cylinder containing said passage and into which chamber said pipe leads, whereby the charge of cool gas and air forming the explosive mixture is delivered against the piston and acts to partially cool and reduce the temperature thereof, a supplementary passage and ports through which the charge is admitted from the compression chamber to the working end of the cylinder, said port being controlled by the operation of said piston.

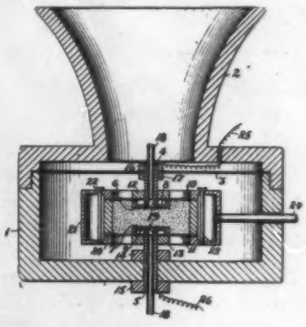
**948,432. Condenser.** Elmer F. Rudeen, Los Angeles, Cal. A steam condenser, comprising a tank, a head in the tank introducing steam and air to the lower compartment, means of



dividing it into upper and lower compartments, means for introducing and withdrawing water to and from the upper compartment, there being communication between the upper and lower compartments for the passage of the steam and air.

**948,833. Composition for Cleaning Boilers.** Eugene Vezie, Washington, Pa. A composition for preventing and removing incrustations in boilers and the like, consisting of coffee, tobacco, balsam weed, Epsom salts, yarrow and pulverized graphite.

**948,609. Wireless Telephone Transmitter.** Albert A. Jahnke, San Francisco, Cal., assignor of one-half to Susan C. Tate, San Francisco, Cal. A telephone transmitter having a



chamber, end walls of which are formed by vibrating diaphragms, and having an annular porous wall, granular material in said chamber, and a chamber surrounding said porous wall and adapted to contain a volatile liquid.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

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604 MISSION STREET, SAN FRANCISCO

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TERMS OF SUBSCRIPTION

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|---|---|---|
| United States, Cuba and Mexico | per year. | $2.50 |
| Dominion of Canada | " | 3.50 |
| Other Foreign Countries within the Postal Union | " | 5.00 |
| Single Copies, Current Month | each | .10 |
| Single Copies, prior to Current Month | " | .25 |

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal." July 1895.
Entry changed to "The Journal of Electricity." September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas." August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
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**Standardization**

The success of American manufacturers depends mainly upon manufacturing in large quantities in standard sizes. This applies as well to I-beams as to watches. In like manner much money is annually lost in making special designs for special purposes, when by a slight change standard equipment could be adopted. According to George Westinghouse, the high cost of manufacturing is largely due to a dearth of uniform standards. In addressing a body of Boston engineers he recently stated that there are probably fifty thousand needless variations in electric motors which have added many millions of dollars to the investment in electric installations. Each maker has his own patterns and designs, one large manufacturer having over ten thousand regular motors available. Yet within a year he had requests for ten thousand more special designs not in stock. This chaotic state of affairs Mr. Westinghouse attributes to that unregulated competition which has prevented co-operation between manufacturers.

The confusion resulting from special governmental specifications is detailed elsewhere in these columns by Charles F. Scott, who states that "a demand for something special, when that which is standard might be used, shows inferior rather than high engineering ability. The best engineer seeks to adopt his conditions so that he may utilize the things at hand, the standard products which are upon the market."

Ever since the twelfth century, when King Henry of England ordered that the ell, the ancient yard, should be the exact length of his arm, the trend of modern progress has been toward standardization. An era of standardization is a necessary corollary to this age of specialization. In many industries, notably the electrical, this fact has been recognized and standards have been adopted by mutual consent of manufacturer and consumer.

An instance familiar to everyone is the standard gauge for track width which was adopted by the railroads years ago. Edison is now quoted as saying that the choice of a four-foot, nine and one-half inch gauge instead of a six-foot gauge was a fundamental mistake and that the latter may yet be adopted. The selection of a standard does not necessarily mean that thereby future changes in the art cannot be utilized. From time to time conferences must be held to keep the standards abreast of the improvements. An excellent example of this is furnished by the standardization rules of the American Institute of Electrical Engineers, which are to be subject to frequent revision. While creative effort is not to be discouraged, there is now a great and crying demand for collaboration and standardization of what has already been accomplished.

**Steam Engineering**

The profession of steam engineering is one whose scope is but partially appreciated by men of other professions. The steam engineer is frequently considered only as a part of the machine or device that public convenience or modern living requires, a mere link in the chain of necessities. Some so-called steam engineers are no better than indicated by this classification. They would not be better in any other vocation. They belong to that self-satisfied, unprogressive host which is easily lost in the multitude. Their very lack of energy assists them to the smooth path of least resistance, where they cannot but journey with the mass whose course is fixed and whose aim is only of today.

But for the progressive men, for the leaders in thought and purpose, those who set the guide-posts of progress and see that this great mass wends its way along without injury to itself, for them the profession of steam engineering is pregnant with all the hope and purpose and reward of science.

When such a man as Professor Robert H. Thurston of Cornell University, whose eminence as an authority on the steam engine is recognized throughout the civilized world, after twenty-five years of uninterrupted employment as a specialist in technical college work and thirty years of practical experience in the design, construction, management and scientific investigation of the principles of the steam engine, when such a man can find in the study of the steam engine and its development an exhaustive application of the principles of chemistry and physics, of the science of energetics and its principal branch thermodynamics, surely it is a subject worthy of the respect shown the learned professions. Its students need fear no sacrifice of dignity when for the advancement of this all-important factor in modern industrial life they go about their duties in the obscure and noisy engine rooms.

The development of the steam engine itself gives proof of the breadth of the profession. Its development has resulted indirectly from the discovery of the mechanical theory of heat, the science of thermodynamics being the direct result of this theory. The application to the steam engine of the laws of heat transference, transmission and transformation, as covered by the principles of thermo-dynamics, was at first crudely and later slowly put into more definite and calculated form. Finally by theory the elimination of unnecessary wastes and the reduction of unavoidable losses has given us the engine of the present day. This latter stage of the development is still in process of rapid advancement.

The principles going into the action of the steam engine include chemical, physical and dynamical transformations. The combustion of the fuel, for example, is a chemical transformation of a very complicated nature and a profitable one for study and research. The generation of steam is in itself a physical phenomenon, as is also the transfer of heat from the fire to the water. The dynamical or energy changes taking place in the engine cycle are, as already stated, the most recent subjects of study, and it is in these that the rapid progress of late years and the prophetic hope for its continuance exist.

Thus the problem before the steam engineer is the determination of the amount of heat energy, or its mechanical equivalent, in a given amount of fuel; the determination of the percentage of this energy which is available by combustion; the percentage of this available energy which actually reaches the water in the boiler; and then the series of subsequent losses due to conduction, radiation, pressure variation, etc., till finally the actual mechanical energy is produced at the piston. This quantity, plus the losses, so determined, should then equal the original calculated amount of energy present. In the analysis of each of these losses, there come into play the principles of the sciences of chemistry, physics, mathematics, and mechanics.

With the steam engine more than with many equally important products of engineering skill, the development has been first experimental and then theoretical. Thus it was not until it was observed that heat was generated when boring a cannon in the middle ages that physicists began the series of calculations which established the law of the mechanical equivalent of heat. The tendency in recent years is, however, toward a reversal of the procedure. In fact, the development of thermo-dynamics as a science has been theoretical and the present-day high economy, high expansion engines, steam turbines and application of superheat, forced draft, etc., are products of advanced theory.

We have, however, much experimenting to do on the theories already advanced before a fixed and standard design can be obtained. Thus it has but recently been found, and this through a co-operation of theory and experiment, that the steam turbine is better adapted to the lower stages of pressure and that the reciprocating engine maintains higher economics in the upper ranges.

This experimenting and standardizing will be done to a great extent by the operating engineers. They have at their command, if they will but exert themselves to possess it, all the knowledge of the engineers and scientists who have preceded them. There is every reason to believe that the rapid advances of the past few years, wonderful as they have been, will be continued in the years before us. The status of the steam engineer of the future is then entirely what he chooses to make it—and all the opinions of the disinterested or possibly envious who see fit to make comment about his affairs cannot in the least affect him.

## PERSONALS.

O. E. Thomas, an electrical engineer from Los Angeles, was in San Francisco this week.

W. H. Kline, formerly tax agent of the San Francisco Gas & Electric Co., is now general agent.

C. E. Groesbeck, general manager of the San Diego Gas & Electric Company, is in San Francisco.

R. B. Elder, district manager of the Allis-Chalmers Company, 160 Second street, San Francisco, is in Los Angeles.

President Scranton of the American Electric Heating Company of Detroit, is calling on the San Francisco trade.

H. C. Keyes, who has natural gas interests in Sacramento, spent a few days in San Francisco on business last week.

C. R. Downs, manager of the Amador Electric Light & Power Company of Sutter Creek, Cal., is a San Francisco visitor.

Julian Thornley has accepted a position as resident engineer at the dam for the Great Western Power Company, with headquarters at Big Bend.

E. F. Scattergood, chief electrical engineer for the Los Angeles Aqueduct Power, has been transferred to the grade of Member American Institute of Electrical Engineers.

H. H. Sinclair, vice-president and general manager of the Great Western Power Company, has returned from an inspection of the hydro-electric transmission plant at Big Bend. He was accompanied on the trip by George R. Field, the assistant manager.

H. R. Sargent, engineer of wiring devices, of the General Electric Company of Schenectady, N. Y., and G. C. Osborn, assistant to the manager of incandescent lamp sales, of the same manufacturing concern, left for the North the middle of the week, after spending several days in San Francisco.

P. D. Wagoner has been elected president of the General Vehicle Company, Long Island City, succeeding J. Howard Hanson, who has withdrawn from the company. Mr. Wagoner brings to his new work a wide experience in engineering and commercial affairs, and under his administration, the outlook for the future of the General Vehicle Company appears very bright.

George C. Holberton, the former engineer of electrical distribution, has been made general manager of the San Francisco Gas & Electric Company, under President John A. Britton. The latter is also president and general manager of the Pacific Gas & Electric Co. Other changes in the titles and personnel of the San Francisco Gas & Electric Co. effective February 15, are as follows: Archie Rice is now in charge of the publicity department; F. E. Cronise has taken charge of the new business department.

H. M. Byllesby of Chicago, who has been prominent in electrical engineering fields for many years, left this week after spending several days in San Francisco with a party of ladies and gentlemen, including W. F. Stevens Jr., of Chicago. Mr. Byllesby has been connected with both the General Electric and Westinghouse interests in past years and now controls electric power systems at San Diego and Coos Bay. It is rumored in engineering circles that he is in the market for additional electric power installations, including, possibly, one near Walla Walla, Wash.

P. M. Hunt, of Hunt, Mirk & Co. of San Francisco, has returned from El Paso, Texas, where he spent the past two months in installing a complete electric power plant for the Southwestern Portland Cement Company. He was accompanied by K. G. Dunn, who made satisfactory tests of the new installation, which includes two 750-kw. Westinghouse-Parsons turbo-generators, boilers and auxiliaries. The power plant occupies a separate building from the cement mill, which is operated throughout by electric motors. The location, on the banks of the Rio Grande river, three and a half miles from the city of El Paso, is a very suitable one for manufacturing.

Newly elected associate members of the American Institute of Electrical Engineers include: E. L. Barnett, electrician, Union Lumber Co., Fort Bragg, Cal.; Elmer Hurd, foreman of construction, Pasco Reclamation Co., Pasco, Wash.; D. F. Keith assistant station superintendent, Grace Station, Telluride Power Co., Provo, Utah; Laurids Lauridsen, engineer, W. S. Barstow & Co., 419 Failing Building, Portland, Oregon; O. L. Le Fever, foreman of subway construction, W. S. Barstow & Co., 419 Failing Bldg., Portland, Ore.; W. A. Newman, electrical inspector, the Board of Fire Underwriters, Portland, Ore.; L. W. Sowles, Utah Light & Railway Co., 130 East Third street, Salt Lake City, Utah; O. C. Warner, second lieutenant Coast Artillery Corps, United States Army, Fort Worden, Wash.; George M. Wills, the Nevada-California Power Co., Goldfield, Nev.

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## LOS ANGELES SECTION A. I. E. E.

The February 25, 1910, meeting of the Los Angeles Section, A. I. E. E., will be addressed by R. W. Shoemaker on the subject of "Electricity in Mining."

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## A. I. E. E. MEETING AT SAN FRANCISCO.

A meeting of the A. I. E. E. under the auspices of the High-Tension Transmission Committee will be held in San Francisco, Cal., on Thursday, April 21, 1910. Among the papers which will be presented at this meeting are the following: "The Economics of a General Power System," by John A. Britton; "The Developed High-Tension Network of a General Power System," by Paul M. Downing; "Hydroelectric Developments and Irrigation," by John Coffee Hays. Further details regarding this meeting will be published later.

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## PORTLAND SECTION, A. I. E. E.

The Portland Section, A. I. E. E., met in the Knights of Pythias Hall at Eleventh and Alder streets, Tuesday evening, February 15, 1910. The following papers were presented: J. J. Brady, "Electric Drive in Car Shops"; A. W. Cochran, "Printing Presses"; R. F. Monges, "Gold Dredging"; H. R. Wakeman, "Conditions of Motor Application on Large Lighting Systems"; L. B. Wickersham, "Electrical Installation for Mining Plants"; G. H. Sampson, "The Separation of Metal by Volatization and Recondensation."

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## ELECTRICAL MEN'S CLUB OF LOS ANGELES.

The Electrical Men's Lunch Club of Los Angeles were entertained by the silvery-tongued orator, Mr. George A. Cole of San Francisco, at the regular monthly meeting February 10, 1910. Mr. Cole outlined the coming exposition to be held in San Francisco and became eloquent in his description of the different prospective exhibits. That he was prepared for the speech was demonstrated by his carefully prepared notes, the accuracy of which is doubtful, because of the fact he missed the date of opening the exposition over a month. However, as no one else was allowed to speak, his remarks were greatly appreciated. Mr. Cole remarked that he had come to Los Angeles to stay for a year, and would appreciate being called upon to make a speech every meeting. (The club pays for the speakers' lunch at each meeting.) Secretary Clapp made a report of the financial standing of the club, which shows sufficient cash on hand to bear the expenses for another six months. Chairman Ballard presided over the meeting, which means success to anything, and the fact of having the privilege of basking in the sunshine of his presence undoubtedly had a great deal to do with calling out the sixty-five members present (Mr. Cole's speech notwithstanding).

# NEWS OF THE STATIONARY ENGINEERS

**PREAMBLE.—This Association shall at no time be used for the furtherance of strikes, or for the purpose of interfering in any way between its members and their employers in regard to wages; recognizing the identity of interests between employer and employe, and not countenancing any project or enterprise that will interfere with perfect harmony between them.**

**Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the business of the Association, and at all times preference shall be given to the education of engineers, and to securing the enactment of engineers' license laws in order to prevent the destruction of life and property in the generation and transmission of steam as a motive power.**

**California.**

No. 1. San Francisco, Thursday, 172 Golden Gate Ave. Pres., P. L. Ennor. Sec., Herman Noethig, 816 York St.

No. 2. Los Angeles. Friday, Eagles' Hall, 116½ E. Third St. Pres., J. F. Connell. Cor. Sec., W. T. W., Curl, 4103 Dalton Ave.

No. 3. San Francisco. Wednesday, Merchants' Exchange Bldg. Sec. David Thomas, 439 Merchants' Exchange Bldg.

No. 5. Santa Barbara. Geo. W. Stevens, 2417 Fletcher Ave., R. R. No. 2.

No. 6. San Jose. Wednesday. Pres., W. A. Wilson, Sec., Lea Davis, 350 N. 9th St.

No. 7. Fresno. Pres., A. G. Rose. Sec., E. F. Fitzgerald, Box 651.

No. 8. Stockton. Thursday, Masonic Hall. Sec., S. Bunch, 626 E. Channel St. Pres., H. Eberhard.

**Oregon.**

No. 1. Portland. Wednesday, J. D. Asher, Portland Hotel. Pres., B. W. Slocum.

No. 2. Salem. A. L. Brown, Box 166.

**Washington.**

No. 2. Tacoma. Friday, 913½ Tacoma Ave. Pres., Geo. E. Bowman. Sec., Thos. L. Keeley, 3727 Ferdinand St., N., Whitworth Sta.

No. 4. Spokane. Tuesday. Pres., Frank Teed. Sec., J. Thos. Greeley, 0601½ Cincinnati St.

No. 6. Seattle. Saturday, 1420 2d Ave. Pres., H. R. Leigh. Sec., J. C. Miller, 1600 Yesler Way.

**Practical letters from engineers and news items of general interest are always welcome. Write your items regardless of style. Communications should be addressed to the Steam Engineering Editor.**

## PRACTICAL MECHANICS.

(Paper No. 7—Continued)

*Axes of rotation crossing.* There has not as yet been devised a means for transmitting rotation between crossing shafts by means of a coupling or rigid intermediate member.

Before leaving link-work transmission, mention should be made of the ratchet or click movements. These are properly classed with this form of transmission because one end of the click or pawl is usually supported by a pin while the other is temporarily acting in a notch which is equivalent to a pin support. The ratchet is applicable in its various forms to axes variously related and is, in fact, a very common form of effecting rectilinear translation from rotation as in the application of certain forms of steam engine lubricators; in the old-fashioned sawmill log feed, or in the machine drill press. Nothing complex is involved in applying ratchet movements where intermittent action is desired; each case having to be considered as it arises and handled as appears most expedient.

*Transmission of Pure Rotation by Rolling Contact.* Having covered the most important cases of transmitting pure rotation by means of a rigid intermediate member, we now proceed to subdivision 1 of the original outline for these papers, (see January 1st, 1910, issue), and shall for a time be concerned with transmission by rolling, on frictional contact.

*Rolling Contact in General.* Rolling contact is understood to imply the driving of one rotating body, the follower, by a driver rolling against it. The axes of motion are necessarily at a fixed distance apart and the point, or line, of contact between the two members will lie in the plane of their centers. The line of contact is a straight line.

As was done in the study of link-work, we shall here subdivide our study into three cases:

1—Axes of rotation parallel either in the same straight line or otherwise.

2—Axes of rotation intersecting, without meeting.

3—Axes of rotation crossing.

In all three cases there are certain features which may receive general consideration.

The velocity ratio will be the inverted ratio of the respective radii to the point of contact. This was shown in paper No. 4, (see issue of January 22d). It is evident that for non-slipping contact the two arcs which have rolled together for any finite time must be of equal length.

For the transmission of power there must be either a component of the driving force normal, or perpendicular to the curves at the contact point, or if this component does not exist there must be a coefficient of friction sufficient to prevent slipping. In order that there may be a normal component of force at the point of contact of two surfaces rolling together the contact radius of the driver must be constantly increasing. Hence for this condition the curves cannot be closed curves.

For the existence of a frictional coefficient there must be a force $P$ pressing the two axles together. The force $K$ tending to drive the follower is then a percentage of $P$ and is usually designated as such that $K = P$.

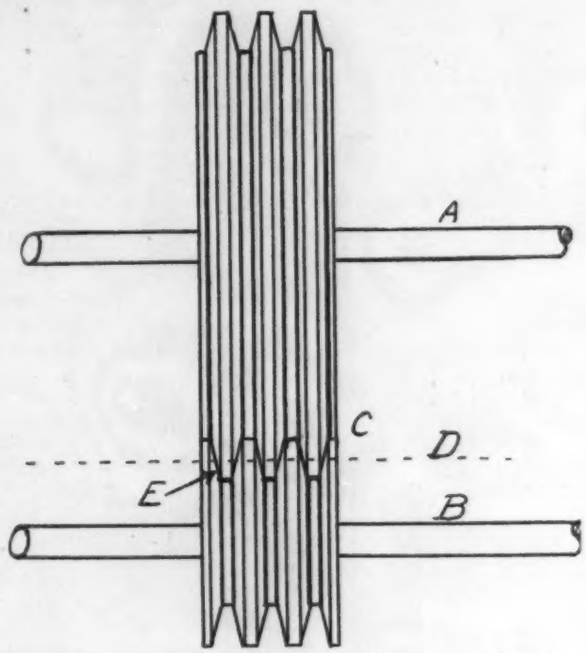



Fig. 8.

If $K$ is to be large it is evident that either $Q$ or $P$ must be large. Since a large force $P$ *means* excessive bearing friction and large journals it is desirable to keep $P$ as small as possible, hence a large frictional coefficient should be obtained. To accomplish this special contact surfaces may be used which have large frictional coefficients. Resort is sometimes had to grooved surfaces which intermember in such a way as to produce heavy pressure between surfaces nearly radial and thus high frictional coefficients are obtained with small bearing pressures. In practice the angles of ridges and grooves are made about 30°. In figure 8, $A$ represents one shaft and $B$ the other, the grooved frictional gearing being shown at $c$. It is obvious that there will be one contact point—the pitch circle shown at $D$ at which there will be no slipping, but other points as $E$, on the groove of either member will be forced to slip or rub. This causes a friction loss which lowers the efficiency. This rubbing has been partially eliminated by making the grooved surfaces curved instead of straight as shown in figure 8 and thereby permitting them to touch in but a single point. The bearings must of course permit of taking up the wear in the grooves. Another disadvantage of grooved gearing is the journal friction which is considerable where any large amount of power is to be transmitted. This form of gearing will be found on ship-winches where efficiency is subordinate to speed and ruggedness.

# INDUSTRIAL

## A NEW TYPE OF CONTROLLER FOR MOTOR DRIVEN VALVES.

Our great waterfalls are among the most awe-inspiring of nature's creations and their grandeur and sublimity have attracted visitors from all parts of the world. Yet nature evidently intended that they should fulfill another mission and play a prominent part in the attainment of a higher state of civilization. At the present day the grandeur of natural scenery is giving place to scenes more in keeping with the requirements of civilization, large hydraulic power houses are springing into existence beside the waterfalls, and the water motor, coupled to the electric generator, is transforming the potential energy of these great masses of water into electric power for transmission to distant points and distribution to the general public.

Fig. 1. Starting Panel of CR 130 Valve Controller.

The certain and quick control of the amount of water to be admitted to the water motor, under all conditions of operation, presents a problem which is best solved by the use of motor driven valves provided with remote control. Such apparatus must be of rugged and substantial construction, as it is subjected to very severe service. The motor is required to start quickly under full load, and thus must take a large starting current. It must also stop instantly.

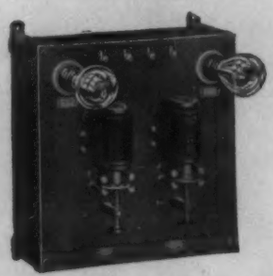


Fig. 2. Control Panel of CR 130 Valve Controller.

The General Electric CR 130 controllers have been designed for this service and consist of three separate parts, starting panel, control panel, and limit switch. The control panel only is placed at the point from which the valve is to be controlled. The starting panel can be placed anywhere, while the limit switch is connected directly to the valve stem.

The general appearance of the starting panel is shown in Fig. 1. The circuit is made and broken by contactors, the magnetic blowout feature of which enables them to open the circuit without appreciable arcing. Two of the contactors close the motor circuit for one direction of rotation and the other two for the reverse direction.

As the majority of the motors operating valves are series or compound wound direct current, those up to and including 5 h. p. may be thrown directly on the line without the interposition of a starting resistance. The panel illustrated in Figs. 1, 2 and 3 is for this service.

The controllers designed for medium sized motors, have additional contactors which cut resistance into or out of the armature circuit. For large motors requiring at least seven steps of starting resistance, the panel is mounted upon pipe supports and the extra contactors are replaced by a solenoid operated switch.

The controllers are equipped with the new CR 187 units which are non-fragile, fire and moisture proof, and thoroughly ventilated.

The control panel shown in Fig. 2 contains two pilot lamps for indicating the position of the valve gates, and two relays for closing the circuit of the coils which close the contactors. The relays are so interconnected that should one be closed and an attempt made to close the other, the one previously closed would open, preventing any possibility of a short circuit resulting from this action and making the device "fool proof."

The switch arm of the limit switch is moved over the contacts by a rod attached to the valve stem. The length of the rod is so adjusted that when the valve is completely opened or closed the limit switch is either at the upper or lower end of its travel, where it short circuits the coils which close the contactors allowing the latter to open, disconnecting the motor from the line.

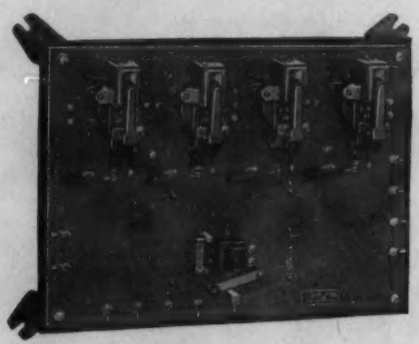


Fig. 3. Limit Switch of CR 130 Valve Controller.

The valve is opened by pushing up the core of the relay marked "to open" on the control panel, closing the circuit through two of the contactors on the starting panel and applying half voltage to the pilot lamp causing it to burn dimly, indicating to the operator that the valve is being opened. When the limit switch opens the line contactors it also applies full voltage to the pilot lamp which then continues to burn at full brilliancy as long as the valve remains open. The pilot lamps indicate the position of the valves at all times.

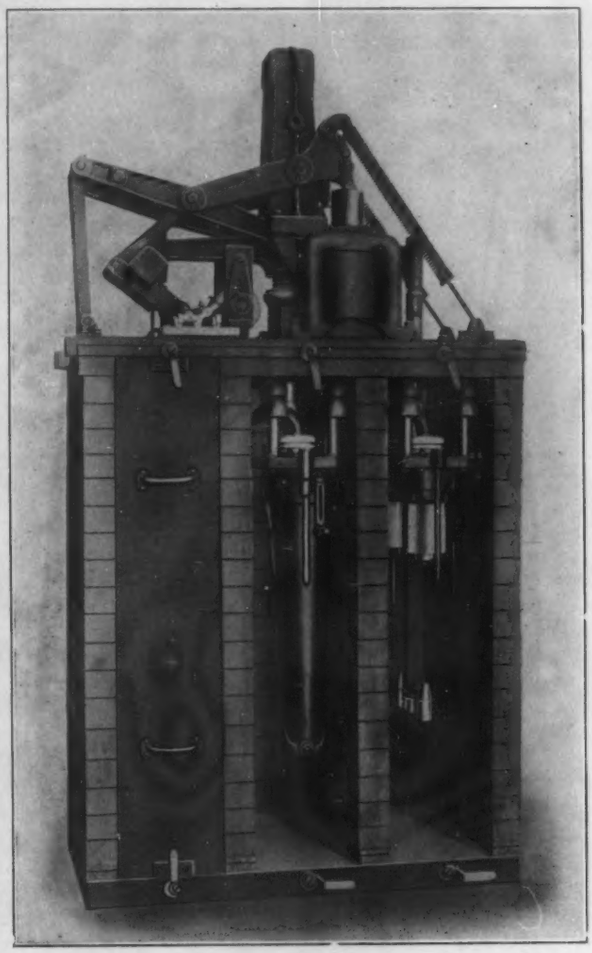
## TRADE NOTES.

H. W. Johns-Manville Co., New York, who are the sole selling agents for the well known line of "Noark" Enclosed Fuses, and accessories, manufactured by the Johns-Pratt Company, of Hartford, Conn., announces that on December 14, 1909, the United States Circuit Court of Appeals for the Second Circuit held that the Sachs Company, and Joseph Sachs its president, have infringed the Sachs patent for enclosed safety fuses, No. 660341, belonging to the Johns-Pratt Company. In the opinion rendered by the court the patented invention is described as "a thin flat metal fuse-strip of extended area in contact over its entire surface with non-conducting filling," and it is said "that the novelty which the patentee sought to secure consisted in making the fuse-strip of thin flat metal of extended area instead of a wire or other strip having a compact sectional area, the object being to increase the surface of the metal with which the filling is in contact, so as to insure its immediate dispersion, when fused, in the filling material." The court holds that the flat strip fuses of the Sachs Company contain this patented invention and are infringements of the patent.

## WESTINGHOUSE NO-VOLTAGE RELEASE TYPE "C" OIL CIRCUIT BREAKERS.

For controlling eight large 6600-volt Westinghouse type "HF" three-phase induction motors, ranging over capacities of 3200, 2500, 2000 and 650 h. p., in the new merchant mills of the Indiana Steel Company, at Gary, the Westinghouse Company has equipped its standard type "C" circuit breakers with a no-voltage release device, which secures the instantaneous opening of the gravity-operated contacts when the control voltage is interrupted.

As shown in the accompanying illustration, one of the toggle-joint members of the standard switch-gear is fitted



Oil Circuit Breaker.

with an armature which engages and is held by the pole pieces of the no-voltage coil, just before the toggle passes its central position. In the ordinary type "C" breaker furnished without this toggle no-voltage release, the contacts are held closed by carrying this toggle over its dead center, where it locks.

In the no-voltage type, the toggle is detained by the attraction of the pole pieces for the armature, while still on the operating side of its center, so that in case of any interruption to the control voltage the breaker immediately opens, and cannot be closed except in the usual manner. Full protection is thus afforded to the motors connected through their circuit breakers, and in the case of overload on the rolls, or failure of the power house, their circuits are immediately opened, so that the machines must be gradually accelerated in the usual way.

Except for the no-voltage release feature, these circuit breakers are similar to the standard type "C" oil breakers built by the Westinghouse Company, and include all the features of solenoid operation, oil submersion of contacts, simple lever switch-gear, gravity opening, and minimum quantity of oil required, which are among the advantages of the well-known type "C" breakers. The breaker is designed for mounting in a brick or concrete structure, separate cells enclosing the sheet-metal switch tanks of each phase. There are two contacts per pole, an effective barrier between pairs of contacts being interposed by the operating rod and insulating lining of the tank. No high tension parts or wiring is exposed when the breaker is assembled. A double-throw, double-pole switch operated by the controlling levers serves as a tell-tale, lighting red or green lamps to show the position of the contacts, whether open or closed.

Besides such special services as large motor starting duty, type "C" oil circuit breakers equipped with no-voltage release will be found extremely useful inserted in the service mains of large power customers, where, by opening the circuit promptly, they will relieve the heavy load conditions met by the power house in restoring service after an interruption.

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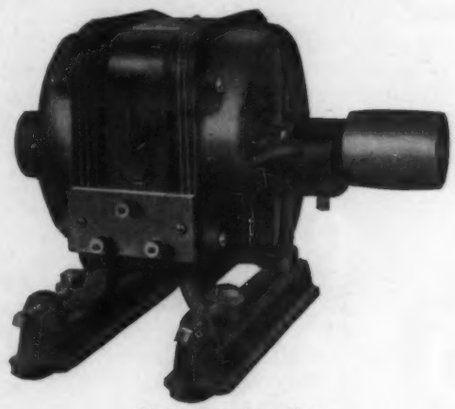
## KIMBLE POLYPHASE INDUCTION MOTOR.

Parrott & Co., Pacific Coast representatives of the Kimble Electric Co., of Chicago, now have in stock a full line of Kimble induction motors including the three-phase machine herewith illustrated. These three-phase motors can he had in sizes varying from ¼ to 7½ h. p. Because of the



Kimble Polyphase Motor

terminal connections on the motor they are particularly easy to install. They are smooth running and so designed as to have a minimum of slip. Their high starting torque combined with low starting current eminently fit them for machine drive. The manufacturers claim a high efficiency and high power factor and also guarantee their product for two years' time.

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Remodeling its generating station at Amarillo, Texas, the Amarillo Water, Light & Power Company has recently installed a Westinghouse bituminous gas-producer plant for supplying its 300 h. p. Westinghouse gas-engine-driven alternator set. This new bituminous type T producer is charged with coal costing $3.50 to $4.75 per ton, and delivers fuel gas having a calorific value of 110 effective b. t. u. per cubic foot. The gas engine is of the single crank horizontal type, with cylinder 18 by 26 inches, and delivers 300-brake h. p. Three-phase, 60-cycle power, generated at 2300 volts, is used for local lighting and power in Amarillo. The development of a successful bituminous gas-producer plant has received the attention of the engineers of the Westinghouse Machine Company for several years, and in this direction severe and prolonged tests were carried out on the apparatus, before the present highly successful bituminous producer was placed on the market.

# NEWS NOTES

## INCORPORATIONS.

SOUTHSIDE, WASH.—The South Telephone Company, with a capital stock of $50,000, has been incorporated by W. A. Kiser, L. J. Coonan and W. R. Ball.

NEHALEM, ORE.—The Nehalem Telephone & Telegraph Company have a capital stock of $3000. The incorporators are S. Scovell, Rudolph Zweifel and Geo. R. McKimens.

ALAMOGORDO, N. M.—The Alamagordo Gas Co., with a capital of $100,000, has been incorporated by Walter Harpst, F. A. Kitchen, E. K. Zimmerman and Geo. Palda of Cleveland, Ohio; A. F. Menger of Alamagordo.

HICKSVILLE, WASH.—The Wheeler Telephone Company of Moses Lake, with a capital stock of $2000, has been incorporated by C. G. Henerson, George O. Rinehart, W. H. Thompson, E. S. Durham and W. E. Kapp.

FULLERTON, CAL.—The Helena Orchard Water Company, of Fullerton, with a capital of $75,000, has been incorporated. The directors are S. F. Catey, Los Angeles; W. S. Davis; A. I. Stewart and F. R. Bain of Fullerton.

SANTA ANA, CAL.—The Red Hills Water Company, with a capital stock of $50,000, has been incorporated. The company is organized for the purpose of buying and selling land and water rights. Tustin is the principal place of business. The directors are C. E. Utt, Sherman Stevens and Mary E. Utt.

SPOKANE, WASH.—Spokane Railway & Power Company, capitalized at $2,000,000, has filed articles of incorporation to build a plant to develop between 30,000 and 35,000 horsepower in the Spokane river, 30 miles below Spokane. The plant will cost $1,500,000 and is to be in operation within two years. The incorporators are D. M. Drumheller and Alfred Coolidge of the Traders' National Bank and H. L. Moody, a local capitalist, the latter being president of the company. Mr. Moody gave out this statement: "We will enter the Spokane market as distributers of electric light. This does not mean that we are in opposition to the Washing Water Power Company, but we recognize Spokane as an open market and we will develop our power for the purpose of sale and distribution in Spokane. We will be able to sell power delivered in Spokane at $14 a horse power. Our power plant will cost about $1,500,000 when completed. We will build a dam at a point on the Spokane river near the Le Pray bridge, which is a famous old landmark in this country. The site has already been acquired and we have secured most of our riparian rights. We expect to develop between 30,000 and 35,000 horsepower with our plant, which will be modern in every respect. Preliminary work will be started as soon as the weather will permit. As soon as our plant is completed we will run power lines to Spokane and the surrounding country."

## TRANSMISSION.

HOPE, B. C.—The Fraser Land Company is preparing to erect a power plant here.

NORTH YAKIMA, WASH.—The Wenas Electric Power Company has been incorporated.

ROUNDUP, MONT.—The Roundup Coal Mining Company is making arrangements for the complete electrification of its line.

WENATCHEE, WASH.—Wenatchee Valley Railway & Power Company has been incorporated for $2500 by H. A. Chapin et al.

PORTLAND, ORE.—Plans are under way for installing a lighting system for First street. To be the same as that on Second street.

BLACKFOOT, IDAHO.—A franchise has been granted to the Idaho Consolidated Power Company to install an electric light, power and telephone system.

WALLA WALLA, WASH.—It is reported that R. A. Stephenson of Mason City, Iowa, and other Iowa capitalists will erect an immense power plant on the Snake river for the purpose of supplying this and other cities with power.

SPOKANE, WASH.—David L. Huntington, general manager of the Washington Water Power Company of Spokane, announces that the plant at Little Falls on the Spokane river, 34 miles below Spokane, will be ready for operation early in June. The work on the plant, which will develop more than 30,000 horsepower, has been in progress 22 months. The turbines, of which there are four, are designed to develop upward of 9000 horsepower if put to fullest capacity. "We now have 100 miles of street railway and 430 miles of high tension transmission line running into neighboring cities and as far away as the Coeur d'Alene mining district," said Mr. Huntington. "Our load is increasing all the time and we will need all the additional power we can develop. Our aim is to keep building just fast enough so as to have a safe margin at all times." With a total length of more than 900 feet, in the neighborhood of 50,000 cubic yards of concrete are required in the construction of the dam and the buildings. With the exception of an opening for the passage of teams the core wall of the dam is practically complete. The generating room is 155 by 71 feet, the transformer and switchboard room being 161 by 70 feet, the height above water level is 80 feet. There is a fall of 68 feet in the stream. The transmission line from the new station will be 28½ miles in length and will connect with the present lines at the Twenty-ninth avenue, sub-station. At present the largest power station in the Northwest is located at Post Falls, Idaho, 24 miles above Spokane on the Spokane river. It is owned by the Washington Water Power Company. Eighteen thousand horsepower can be developed at this plant. The Washington Water Power Company's station at the falls in Spokane is capable of developing 12,000 horsepower.

## TRANSPORTATION.

OAKLAND, CAL.—An electric road franchise asked by the Peninsula Railway Company, has been voted advertised.

ASTORIA, ORE.—Preparations are being made to commence the grading for the line of the proposed electric railway to Seattle.

SEATTLE, WASH.—The Puget Sound Electric Company is planning to make improvements to cost $376,591 in its line between Seattle and Tacoma.

SAN RAFAEL, CAL.—Active steps are being taken to build an electric street railway from Corte Madera through Ross Valley towns and San Rafael to McNears Point.

ONTARIO, CAL.—The City Council passed an ordinance granting to Wm. G. Kercheff the right to construct and maintain an electric railway upon certain streets in this city.

ALBANY, ORE.—The Albany Interurban Railway Company has been incorporated for the purpose of building an electric railway from here to Sweet Home. P. A. Young is one of the incorporators.

ABERDEEN, WASH.—At the last meeting of the County Commissioners the Grays Harbor Interurban Company made

application for a new franchise to operate a trolley line on the roads of Chehalis County.

PORT ANGELES, WASH.—The Port Angeles Power & Electric Company, capital $80,000, has been incorporated by Frank MacKean, Pacific block, Seattle, and R. H. Bethel.

LOS ANGELES, CAL.—The Board of Supervisors is receiving sealed bids for furnishing the county one single 220 volt, 4 ton electric locomotive, to be delivered free on board the cars at the Pacoima rock quarry.

BERKELEY, CAL.—The S. P. Company has petitioned the City Council for the withdrawal of its application for a change in the franchise granted last year, and also asks for a new franchise, changing the line of the road some 300 feet on California street in the northern part of the city. The application has been referred to the committee of the whole, and a report will be made at the next meeting of the City Board.

LOS ANGELES, CAL.—The Assistant City Attorney has announced that the Los Angeles Pacific Railway Company has agreed to stop laying further tracks on Western avenue, Colegrove district, until the company's rights there are definitely ascertained. Between Monticello and Benedict streets, the avenue is but 60 feet in width and ties were laid in the gutter, making the adjoining property inaccessible. The Board of Public Works wants the tracks laid in the center of the avenue.

OREGON CITY.—The Portland Railway, Light & Power Company has commenced the construction of an electric railway from West Oregon City to Oswego, a distance of four miles, in order to handle the logging business for the Willamette Pulp & Paper Company, the Crown-Columbia Pulp & Paper Company and the Hawley Pulp & Paper Company. The line will be an extension of the Willamette Falls Railway, running south from West Oregon City past Willamette. It is intended to have the road in operation in three months.

SAN FRANCISCO, CAL.—Dr. Hart'and Law and a special committee of the Neb Hill Association have had preliminary plans prepared for a tunnel under that part of Stockton street from Bush street to a point a short distance north of Sacramento street. It is estimated that this work will cost between $350,000 and $375,000, a small sum in comparison with the benefits to be derived from the improvement, in the opinion of the members of the association. The plans call for a tunnel as wide as the street, which is to be lined with glazed brick, thus combining ornamentation and utility. The grade in the tunnel is not to be over 3 per cent.

SACRAMENTO, CAL.—As soon as the Northern Electric Railroad secures the permission of Sacramento and Yolo counties and the government to erect a bridge across the Sacramento river from this side the extension of the line to Woodland will be undertaken. This is the information which comes indirectly from company officials. President Lilienthal of the Northern Electric states that Sacramento was the logical market for the residents around Dixon and Woodland, but would give no details of a contemplated extension of the trolley line there. Mayor Beard has offered a solution to the Northern Electric's plan to cross the river at M street, which is meeting opposition, by suggesting that the new bridge cross at I street.

RED BLUFF, CAL.—The Northern Electric Railway Company, now operating the system between Sacramento, Oroville, Marysville and Chico, has filed deeds here by which it secures rights of way across Los Molinos colony in this county, 12 miles below Red Bluff. The deeds are granted free on condition that the railroad be extended from Chico to Los Molinos before the end of 1910, and on to Red Bluff before the close of 1911. It is supposed that the company will stop building at Los Molinos, and the completion of its road to Red Bluff this year is confidently expected, with an an extension to Redding and Kennett next year. Other necessary rights of way have nearly all been secured, and they are near the line of the Southern Pacific nearly the entire distance. The deeds just filed cover 12 miles of the distance between Chico and Red Bluff. The road will pass through one of the best portions of the Sacramento Valley, where rapid development is taking place on account of the influx of Eastern people. The company will also soon build from Yuba City through Meridian and Colusa to Hamilton City.

ALAMEDA, CAL.—That electric trains will be running on the Alameda main local lines to the Alameda mole by April 1 has been announced by F. W. Hoover, industrial agent for the Southern Pacific. The powerhouse, which will supply power for all the electric lines on this side of the bay, will not be finished until August 1, but Mr. Hoover states that the railroad company had a contract with the Great Western Power Company to supply current for the electric trains until the powerhouse can be put into operation. Poles to carry the high power lines have been erected along Encinal and Lincoln avenues, and the roadbed has been prepared for the new traffic and heavier rails installed where necessary. The work on the loop around the east end of the city is nearly finished. The Linderman estate has held up the work on the loop extension, but it is said that the city of Alameda will condemn the right of way if necessary. Seven new stations on the local lines are under course of construction. As soon as the Alameda lines are electrified work will commence on the extension across the estuary to the Franklin street station.

## ILLUMINATION.

FOREST GROVE, ORE.—The City Council has authorized the Mayor to buy machinery for a plant to supply Forest Grove with electric lights.

GEORGETOWN, WASH.—Robert M. Jones has been granted a franchise to erect, maintain and operate a gas, electric light and power works.

KENNEWICK, WASH.—The Hanford Irrigation and Power Company will resume the improvement work started in the town of Hanford last year, including a water and lighting system.

SEATTLE, WASH.—The American Gas & Electric Power Company, of which B. H. Silver is president, will build its first producer gas power plant in Georgetown. The plant is to be in operation within a year.

DRAIN, ORE.—The City Council has passed an ordinance to light the city with electricity, making a 20-year contract with the Drain Electric Light & Power Company. The company is to begin work within 30 days, and finish in eight months.

REDLANDS, CAL.—The new power plant of the Southern California Edison Company, proposed to be built in Santa Ana canyon, will probably be begun this spring or summer. The plant will have a capacity of 7000 kilowatt and cost about $600,000.

VENICE, CAL.—District Agent A. W. McPherson of the Southern California Edison Company has received official notice that reports of the gas experts of the company have received favorable executive action, and that work of rehabilitation and manufacturing and distributing systems at Ocean Park and Santa Monica will be commenced immediately.

DEMING, N. M.—Secretary E. A. Lane of the Deming Ice & Electric Company, and Manager Cameron, state that their plant will be increased in capacity. There will soon be installed two boilers of 250 h. p. each. The capacity of the ice plant will be about doubled and the electric business will

be increased. A large steam turbine will be directly connected to generator.

BAKERSFIELD, CAL.—The Standard Oil Company, which has for some time been using gas from its big gas well at Midway in its furnaces in the west side field, has laid a 4-inch main to the Rio Bravo pumping station of the Kern River-Midway pipe line, and for the past week has been burning gas there also. Tests are now being made at Midway to ascertain the velocity with which the gas flows through the pipe and to secure other data, which, if considered satisfactory, may result in continuing the pipe line to the Kern River field. The week's test of the gas at the Rio Bravo station demonstrates to a practical certainty the full feasibility of piping gas from Midway to supply heat and light in Bakersfield, provided a sufficient supply is obtained, and for this there is good reason to hope from the showing of the Standard's Midway well, which is capable of supplying 12,000,000 feet daily, with a pressure of 470 pounds. The amount used in the big furnaces of the pipe line is not missed from the well's apparent supply. The Standard's well at Midway which started off at 5000 barrels, is now flowing about 1500 barrels per day.

PORTLAND, ORE.—Seymour H. Bell, of 780 Kearney street, has returned from Tacoma, having sold the holdings of the Coos Bay Gas & Electric Company, at Coos Bay, to the H. M. Byllesby Company, owners of the Tacoma Light Company and several other plants throughout Washington, Montana and Idaho. The Coos Bay Gas and Electric Company owns the electric lighting plant at Marshfield and North Bend with a gas plant supplying both cities, located at the latter place. Associated with Mr. Bell in the company have been Henry Hewitt Jr., of this city, who owned the majority of the stock, and L. J. Simpson, of North Bend. Next to Stone and Webster, the H. M. Byllesby Company are the largest public service people on the coast and the purchase of the plant at Coos Bay is their first acquisition of property in Oregon. There has been a general renewal of activity in all lines of business at Coos Bay in the past few weeks and the announcement of a $400,000 deal will give fresh impetus to the already rapidly rolling ball. The property of the Coos Bay Gas & Electric Company consists of the old electric lighting station at Marshfield with a 35-year franchise for gas and electricity, and the new gas and electric power plant at North Bend, which is the central station, with a 50-year franchise for both gas and electricity there. The company has been supplying 24-hour service for two years.

## TELEPHONE.

CENTERVILLE, WASH.—The Centerville Telephone Company has been incorporated for $5000 by Henry Garner et al.

SANDPOINT, IDAHO.—Articles have been filed for the Bonner County Telephone Company by T. C. Bell of Wallace.

WENATCHEE, WASH.—The South Side Telephone Company has been incorporated by W. A. Kiser et al. About 60 phones will be installed.

ZILLAH, WASH.—The Yakima Valley Telephone Company, C. H. Furman of this place, manager, will extend its service in Toppenish and Mabton.

TOPPENISH, WASH.—The Yakima Valley Telephone Company has increased its stock and will install a large number of phones in the city within the next three months.

PORTLAND, ORE.—The McCormick Lumber Company has closed a contract for the installation of wireless apparatus on its steamers—the Yosemite, Yellowstone, Cascade and Shoshone.

TWIN FALLS, IDAHO.—The Twin Falls-Jarbidge Telephone & Telegraph Company, M. J. Kirkpatrick is president, will soon begin the construction of a telephone line into the Jarbidge mining camp, 100 miles distant.

SANDPOINT, IDAHO.—C. R. Potter, present manager of the Interstate Telephone Company and farmers in the vicinity of Sagle, Cocolalla and Westmond, are taking steps to install a rural telephone service. Fifty miles of line will be constructed at a cost of $5,500.

## WATERWORKS.

DORRIS, CAL.—The trustees of Dorris are negotiating with the United Iron Works of Oakland for a system of water works.

CRUSICK, WASH.—J. W. Crusick has purchased the engine, pump and tanks of the Irene Water Company and will install a water plant.

SILVER CITY, N. M.—The secretary of the treasury has submitted a letter to congress recommending an appropriation of $65,000 for a water supply at Fort Baynard, N. M.

BELLINGHAM, WASH.—Sealed bids are being received by J. H. Korthauer, city comptroller, for furnishing the city of Bellingham's water department with cast iron water pipes.

PACIFIC GROVE, CAL.—The Grove waterway contract has been let to Edward Simpson and C. W. Van Horn. This pipe line will run from Pine to Lighthouse by the way of Fourteenth street.

REDWOOD CITY, CAL.—At the suggestion of Mr. Tuchson the street superitnendent was instructed to lay water mains in Iris, Jeter, King, Lowell, Myrtle, Nevada and Hopkins streets before the streets are paved.

SEATTLE, WASH.—The City Council has passed a resolution for the improvement of Ninth avenue and Ninth avenue north from Westlake avenue north; Denny way, from the westerly margin of Ninth avenue, north to Westlake avenue; John, Thomas, Harris, Republican and Mercer streets, each from Ninth avenue, north to Westlake avenue north; and Roy street from Eighth avenue north to Westlake avenue north by the construction of sewers and water mains.

SAN JOSE, CAL.—Judge S. F. Lieb has received a telegram from Sacramento informing him that the Supreme Court had affirmed the judgment of the Superior Court of this county enjoining the Bay Cities Water Company from appropriating the water, subterranean and flood, of the Coyote river. The suit was one of a number instituted to restrain the water company from taking the water supply of the county which comes down the Coyote river. The case has been pending for a number of years, Judge Rhodes, then sitting in Department 3 of the Superior Court, having given judgment in 1905 against the Bay Cities Water Company, enjoining them from interfering with the Coyote waters. The Coyote river is the largest body of water in the county, over 200 square miles of mountain watershed being drained by it. Opposite the 18-Mile House on the Monterey road it bursts into the valley, and it again contracts down at the 12-Mile House so that it becomes nothing but a rocky gorge 300 to 400 yards wide and less than 100 yards deep. Underlying its course and for considerable depths to hardpan are immense areas of gravel which comprise great reservoirs that feed the underground streams leading to the artesian wells of the county. At the point named the Coyote is 240 feet above the bay and 140 feet above San Jose. It was estimated that this water supply would amount to 20,000,000 gallons a day and it was the purpose of the Bay Cities Water Company to impound this water and sell it to the highest bidder. It was offered to the city of San Francisco, and the company proceeded to put down machinery and pumps of a capacity to handle that amount of water, some of the works being sunk 80 feet below the surface of the ground. To restrain them from taking these waters was the purpose of the suits brought.